CLADDING SAFETY Victoria

Protocols for Mitigating Cladding Risk
Cladding Risk Policy

E.02 – Sprinkler Protection

Version 3

Date: 2 July 2025

OFFICIAL

Victoria State Government

Aboriginal acknowledgement

Cladding Safety Victoria respectfully acknowledges the Traditional Owners and custodians of the land and water upon which we rely. We pay our respects to their Elders past, present and emerging. We recognise and value the ongoing contribution of Aboriginal people and communities to Victorian life. We embrace the spirit of reconciliation, working towards equality of outcomes and an equal voice.

Application of Minister's Guideline 15

These documents contain information, advice and support issued by CSV pursuant to Minister's Guideline 15 - Remediation Work Proposals for Mitigating Cladding Risk for Buildings Containing Combustible External Cladding. Municipal building surveyors and private building surveyors must have regard to the information, advice and support contained in these documents when fulfilling their functions under the Act and the Regulations in connection with Combustible External Cladding on buildings:

a) which are classified as Class 2 or Class 3 by the National Construction Code or contain any component which is classified as Class 2 or Class 3;

b) for which the work for the construction of the building was completed or an occupancy permit or certificate of final inspection was issued before 1 February 2021; and

c) which have Combustible External Cladding.

For the purposes of MG-15, Combustible External Cladding means:

a) aluminium composite panels (ACP) with a polymer core which is installed as external cladding, lining or attachments as part of an external wall system; and

b) expanded polystyrene (EPS) products used in an external insulation and finish (rendered) wall system.

Disclaimer

These documents have been prepared by experts across fire engineering, fire safety, building surveying and architectural fields. These documents demonstrate CSV's methodology for developing Remediation Work Proposals which are intended to address risks associated with Combustible External Cladding on Class 2 and Class 3 buildings in Victoria. These technical documents are complex and should only be applied by persons who understand how the entire series might apply to any particular building. Apartment owners may wish to contact CSV or their Municipal Building Surveyor to discuss how these principles have been or will be applied to their building.

CSV reserves the right to modify the content of these documents as may be reasonably necessary. Please ensure that you are using the most up to date version of these documents.

Document Notes

The Protocols for Mitigating Cladding Risk (**PMCR**) is an approach developed by Cladding Safety Victoria (**CSV**) on behalf of the Victorian Government to consistently and systematically address the risk posed by the presence of combustible cladding on Class 2 and Class 3 buildings.

For many buildings, combustible cladding on the facade:

- does not present a high enough level of risk to warrant substantial or complete removal of the cladding; but
- presents enough risk to warrant a tailored package of risk mitigation interventions to be introduced that provide a proportionate response to the risk.

Some buildings may be of a construction type or size or may only comprise limited elements of combustible cladding such that no intervention or removal of cladding is required.

A set of documents has been assembled to describe the purpose, establishment, method and application of the PMCR. The full set of PMCR documents and their relationship to each other is illustrated in a diagram in Appendix A: PMCR document set and flow.

There are **seven** related streams of technical document in the PMCR document set:

A. Authorisation	Codifies the Victorian Government decisions that enable PMCR activation.
B. CRPM Methodology	Specifies the Cladding Risk Prioritisation Model (CRPM) method used for assessing cladding risk and assigning buildings to three risk levels.
C. PMCR Foundation	Defines the PMCR method, objectives and the key design tasks.
D. Support Packages	Captures the relevant risk knowledge and science-based findings necessary to systemise and calibrate PMCR application.
E. CSV Cladding Risk Policy	Establishes key CSV policy positions in relation to cladding risk.
F. PMCR Interventions	Identifies and describes the interventions that the PMCR method can employ to mitigate risk associated with combustible cladding.
G. Implementation	Specifies the standards and procedures that guide PMCR application.

The document set has been developed by CSV. Each document has a function in supporting the delivery of the PMCR and in communicating the PMCR risk rationale and method.

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Abbreviations

Term	Meaning
ACP-PE	Aluminium Composite Panel with a polyethylene core
CFSR	Cladding Fire Spread Risk
CRMF	Cladding Risk Mitigation Framework
CRPM	Cladding Risk Prioritisation Model
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CSV	Cladding Safety Victoria
EPS	Expanded Polystyrene
FPAA	Fire Protection Association Australia
Framework	Cladding Risk Mitigation Framework CRMF
IF-SCAN	Initial Fire Spread in Cladding Assessment Number
MBS	Municipal Building Surveyor
MG-15	Minister's Guideline 15
NCC	National Construction Code
NFPA	National Fire Protection Association
PMCR	Protocols for Mitigating Cladding Risk
RWP	Remediation Work Proposal
RIS	Rise In Storey – as defined in the National Construction Code
SOU	Sole Occupancy Unit – as defined in the National Construction Code

1 Introduction

Cladding Safety Victoria (**CSV**) has developed and is implementing the Protocols for Mitigating Cladding Risk (**PMCR**) to provide a structured framework for responding to the risk posed by combustible external cladding on Victorian Class 2 and Class 3 buildings.

Sprinkler protection in a building significantly reduces the risk to life safety posed by fire. There is substantial international fire incident data and research available to demonstrate the extent to which sprinklers significantly reduce the rate of death and injury in the event of fire. In parallel, regulatory fire safety practice world-wide continues to extend the requirements for sprinkler protection in residential buildings in recognition of the safety benefits of sprinklers.

CSV has developed cladding risk policies to support the Victorian Government in ensuring that there is a measured and proportionate response to cladding risk in Victoria under the PMCR.

A key policy question that CSV has considered is the extent to which the removal of combustible external cladding is necessary in residential buildings that are protected by sprinklers.

This policy is informed by CSV experience in assessing cladding risk for hundreds of buildings over four years. The design of this policy draws upon the expertise provided by CSV's internal technical team of building surveyors and fire engineering experts, international research, CSV initiated research and ongoing consultation with those who have a role and interest in fire safety and cladding risk.

1.1 Document purpose

The purpose of this document is to present the CSV policy that informs the standardised response to cladding under the PMCR for scenarios involving the presence of sprinklers in a building.

This document provides:

▪	A brief historical account of the expanding use of sprinkler systems as a cornerstone strategy in evolving regulatory fire safety practice;	(Section 3)
▪	An overview of the risks faced by building owners and occupants due to the presence of combustible external cladding on their buildings;	(Section 4)
▪	Key data and findings of international and CSV research that evidence the benefits of sprinkler protection to building occupants and fire fighter safety;	(Section 5)
▪	Information about the types of sprinkler systems that may be installed in a building, consistent with the National Construction Code (**NCC**); and	(Section 6)
▪	Cladding risk policy parameters developed by CSV for the application of Cladding Rectification Standards.	(Section 7)

2 Background

Cladding Safety Victoria (**CSV**) was established in July 2019 to support Victorian building owners and regulators of building safety in making Class 2 apartment buildings with combustible external cladding safer. Since being established, CSV's risk mitigation scope has been extended to include Class 3 buildings[1].

The key driver for CSV's establishment (mirrored by government actions world-wide) was to avoid catastrophic cladding fuelled fires like the one that claimed 72 lives at Grenfell Tower in London in June 2017.

In assessing cladding risk and developing risk mitigation solutions, CSV gives primacy to life safety.

CSV employs a risk assessment method to identify those buildings where cladding fuel loads are substantial enough to make a large-scale cladding fire possible (these are low probability, high consequence events). Based on these assessments, CSV has funded projects to remove cladding from 366 buildings and eliminate or substantially reduce[2] the cladding risk for the occupants and users of those buildings.

There are several hundred additional buildings known to CSV that are awaiting a response to the risk presented by cladding. Many buildings have small amounts of cladding or cladding that is decorative only. Risk mitigation solutions requiring full or extensive cladding removal for most of the remaining CSV buildings cannot be justified on risk-based grounds, and alternate solutions must be considered.

Over four years of operation, CSV has reviewed thousands of buildings, consulted with numerous stakeholders and experts, and developed a tremendous depth and breadth of experience about the risk posed by combustible cladding and the options for treating that risk.

The Protocols for Mitigating Cladding Risk (**PMCR**) are being developed by CSV, within the context of the Victorian Cladding Risk Mitigation Framework (**CRMF**).

The purpose of the CRMF and PMCR is to provide a structured and systematic method for designing risk mitigation solutions that constitute a reasonable, evidence-based and proportionate response to the cladding risk associated with Victorian Class 2 and Class 3 buildings.

The CRMF provides for the cladding risk of a building to be rated on the basis of:

1. the extent of potential fire spread across a building facade via cladding (the more apartments that are connected by cladding, the higher the cladding risk); and
2. the extent of sprinkler protection available within a building (acknowledging the evidence and recognition that the presence of sprinklers greatly reduces the risk to life in a building fire).

A founding design principle of the CSV risk approach, is that for sprinkler protected buildings, a greater facade fire spread risk can be tolerated/accepted compared to buildings without sprinkler protection.

CSV has used the assembled evidence and knowledge about sprinkler protection to reassess the risk faced by building occupants where sprinkler protection is in place. CSV's risk perspective is also shaped by the views of key stakeholders in matters of building fire safety (regulators, fire fighters, insurers and fire safety experts).

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[1] The Victorian Building Authority defines Class 3 buildings as follows:

Residential buildings other than a Class 1 or Class 2 building providing long-term or transient accommodation for a number of unrelated persons. For example:

- boarding house
- hotel, motel or guest house
- hostel or backpackers
- student accommodation or workers' quarters
- residential care building

[2] There were 69 buildings for which remediation works involved a performance solution, which entailed the retention of small amounts of cladding in some cases.

This CSV Cladding Risk Policy establishes the parameters for the design of PMCR risk mitigation solutions:

1. Recognising the safety benefits of existing sprinkler protection in a building; and
2. Adding sprinkler protection (where not already in place) as an intervention within a Remediation Work Proposal (**RWP**).

3 Recognised safety benefits of sprinklers

The use of sprinkler protection in PMCR solutions is compatible with and supportive of world's best practice in building fire safety.

The National Construction Code (**NCC**) incorporates prescribed performance standards that serve to reduce the risk to **life safety** in Australian buildings as a result of fire.

"Risk to Life Safety

The fire safety provisions in the NCC have been developed over time to address two types of risk; individual risk, that is the risk of fatality or injury to a person or persons within the room of fire origin, and societal risk, that is the risk of fatality or injury to other occupants who may have little or no control over the activities or circumstances that lead to fire, but are exposed to its effects. When considering changes to the fire safety provisions it is necessary to consider how both types of risk will be impacted."
Source: Fire safety in new Class 2 and Class 3 residential buildings, Regulation Impact Statement for decision, Australian Building Codes Board, November 2018

The threat to life is the primary consideration in building design requirements when contemplating matters of fire safety under the NCC, with potential property losses due to fire being of secondary concern.

3.1 Sprinklers and regulatory safety practice

Automatic sprinkler systems are an integral part of sound fire safety design in Australian buildings, supported by NCC performance requirements that mandate their use in particular construction scenarios.

For many years, the installation of automatic sprinkler systems has been mandatory for all Class 2 buildings that are greater than 25 metres in effective height. This requirement reflects the understanding that the ability to fight a fire at height and to safely evacuate building occupants in a timely fashion is more challenging when dealing with a building fire at height.

The NCC requirements in relation to sprinkler protection have been extended in recent years in response to the recommendations of a coronial enquiry into the Bankstown fire of 2012 and investigations of the balcony fire that caused the Lacrosse fire in 2014. Amendments to the NCC have been introduced which require:

- sprinkler protection to be provided to covered balconies (previously not required where the floor area of the balcony is less than $6m^2$ or the depth of the balcony is less than 2m) for all new multi-storey residential buildings, hotels, healthcare buildings and aged care buildings that are required to install sprinklers designed to AS 2118.1 (applies in Victoria from 15 December 2015)[3]; and
- new Class 2 and 3 building with a rise in storeys of four or more (and an effective height of 25 metres or less) to have a sprinkler system as detailed in FPAA101D, FPAA101H, AS 2118.1 or AS 2118.4 (applies from 1 May 2019)[4].

These changes benefited from the advocacy of those responsible for fighting fires in Victorian Buildings:

"Following the advocacy of the Australasian Fire and Emergency Service Authorities Council (AFAC) and key stakeholders including MFB, the 2019 National Construction Code came into effect in 2019, making automatic fire sprinkler systems a mandatory requirement for all new residential apartment buildings that are four storeys and above in height. This significant improvement in fire safety requirements for apartment buildings is a direct result of a collaborative approach between MFB, fellow AFAC member agencies and the Fire Protection Association of Australia, providing a safer built environment for the community."
(Source: Annual Report 2019 – 2020, Metropolitan Fire Brigade, 30 November 2020*)*

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[3] *Automatic Fire Suppression Systems for Covered Balconies in Residential Buildings: Final Decision RIS*, Australian Building Codes Board, June 2016.

[4] https://ncc.abcb.gov.au/news/2019/new-residential-fire-sprinkler-requirements-ncc-2019

The Fire Protection Association Australia (**FPA Australia**), with a broad membership drawn from across the domestic fire safety sector/industry, welcomed these changes to the NCC. The Chief Executive Officer of FPA Australia at the time of the NCC amendments, Scott Williams, stated:

"Automatic sprinklers are one of the most effective life protection measures in a fire. This change to our national building rules will dramatically improve the safety of residents living in the 700-plus new medium-rise buildings of this type built each year . . .

This is truly a major milestone for all of those involved in this wonderful collaboration, but mostly importantly the community will see the risk of fire in these types of building reduced significantly."
(Source: http://www.fpaa.com.au/news/news/2018/12/new-sprinkler-rules-will-save-lives.aspx , 19 December 2018*)*

It is indisputable that there is broad based advocacy and support for the increased use of automatic sprinkler systems as a core fire safety feature in Australian building design. PMCR design must, therefore, continue to reflect the value of sprinkler systems in enhancing life safety and pursue opportunities to support the expanded use of sprinklers in Victorian Class 2 and 3 buildings where it is feasible and practical to do so.

The benefits to life safety of automatic sprinkler systems have been well researched and documented, and are the subject of discussion in section 5 of this document.

3.2 International requirements for sprinklers

Extending the regulatory mandate to deploy sprinkler system use is not restricted to Australia.

Over two decades, United States codes and standards have been progressively extending the requirement for sprinkler protection to encompass additional building and dwelling types:

"The 2009, 2012, 2015, 2018 and 2021 editions of the International Residential Code (IRC) join the National Fire Protection Association's (NFPA) Life Safety Code and the NFPA Building Code in requiring fire sprinklers to be installed in all new homes. The NFPA codes have included this requirement since 2006 . . .

Building codes have been progressively phasing in fire sprinkler requirements for all residential occupancies over the past 20 years, beginning with hotels, motels, condominiums and apartments; extending to include some townhouses in 2000 and all townhouses in 2009; and finally extending to include all new homes in 2011."
(Source: http://ircfiresprinkler.org/codes-and-standards/ , International Residential Code Fire Sprinkler Coalition, 2016*)*

In 2020, amendments were made to the *Building Regulations 2010* in England that reduced the height at which sprinklers were required in new flats from 30 metres to 11 metres.

"7.4 Blocks of flats with a top storey more than 11m above ground level (see Diagram D6) should be fitted with a sprinkler system throughout the building in accordance with Appendix E.

NOTE: Sprinklers should be provided within the individual flats, they do not need to be provided in the common areas such as stairs, corridors or landings when these areas are fire sterile."
(Source: Approved Document B (fire safety) volume 1: Dwellings, 2019 edition incorporating 2020 and 2022 amendments, United Kingdom Government, 2022)

In Scotland, new requirements for sprinkler protection have been encoded in regulation, effective from 1 March 2021, that apply to a broad range of dwelling types:

"The Scottish Government has published The Building (Scotland) Amendment Regulations 2020 which will require all new apartments, new shared multi-occupancy residential buildings and all new social housing to be protected with sprinklers. The change will take effect on 1st March 2021. From that date all housing in Scotland, with the exception of privately-owned, single-family homes, will need to be sprinklered.
Source: https://www.eurosprinkler.org/scotland-requires-sprinklers-in-new-apartments-and-all-new-social-housing/ ,
European Fire Sprinkler Network, 17 September 2020

Dwelling type and height specific requirements for mandatory sprinkler system use also apply to many other jurisdictions.

3.3 Insurance and sprinkler protection

The presence of combustible cladding on a building changes the risk profile of that building and impacts the way that the insurance industry prices risk and sets insurance premiums.

A burgeoning cost for building owners living with cladding is the cost of insurance, as illustrated in the case study below.

Case Study[5]

A building funded for cladding rectification by CSV located in Brunswick, was clad in a mix of expanded polystyrene and aluminium composite panelling, the same material that was used on the Grenfell Tower.

Last year, the apartments suffered a small, quick-spreading fire that brought attention to its cladding.

Consequently, in November 2017, the owners were required to pay an insurance premium of $134,000 (which was $29,000 the previous years). In addition, their excess rose from $1,000 to $100,000.

Further, in December 2017, Moreland Council gave the owners corporation orders to carry out works to make the 105 apartments safe within three months. The order required immediate action that will cost owners around $250,000.

Finally, the owner's corporation researched replacing the cladding, and discovered that it would cost between $2 million and $3 million to replace the non-compliant cladding.

The owners have begun legal action against the builder to recover the costs of fixing the nine-level tower.

Source: https://kerinbensonlawyers.com.au/building-cladding-crisis-insurance/

The Industry Council of Australia (**ICA**), in its *Residual Hazard Identification/Reporting Protocol for ACP and other Combustible Façade Materials,* indicates that risk based premium setting is influenced by "effective risk mitigation measures":

"Insurers in providing insurance cover for a building, set premiums according to the residual risk (considering effective risk mitigation measures implemented for the building), of damage occurring and a claim being made against the policy. The higher the probability of a damaging event occurring, the higher the premium."
Source: https://insurancecouncil.com.au/wp-content/uploads/resources/ICA%20reports/2020/201117_ACPRHP_ICA_16092020.pdf , 16 September 2020

Substantial evidence exists to demonstrate that the use of automatic sprinkler systems constitutes an "effective risk mitigation measure", and insurance sector/industry recognition of such should be reflected in premium discounts.

There is little empirical evidence in an Australian context as to the level of premium discount to be expected where a building has effective sprinkler protection, although insurance brokerage communications consistently indicate that insurance discounts for sprinkler protected buildings should be expected.

A United States study conducted by the Fire Protection Research Foundation in September 2008 reviewed the insurance premiums set by the five top insurance companies in each of nine states. Discount rates for the use of residential sprinkler systems were computed for each state.

"Discount savings percentages are derived from the whole annual homeowner's insurance premium (rather than just a portion of the premium). Discount savings percentages ranged from 0 to 10% among all companies and agencies surveyed, with an average discount savings percentage premium of 7%."
Source: Home Fire Sprinkler Cost Assessment – Fire Protection Research Foundation, September 2008

[5] Cladding rectification work for this buildings was fully funded by CSV and works have been completed.

A key function of CSV in its implementation of the PMCR and as a key stakeholder in the implementation of all Victorian Cladding Taskforce (**VCT**)[6] recommendations, is to provide evidence that informs insurance premium risk pricing for buildings with cladding, particularly where risk mitigating interventions, like sprinkler protection, are already in place or are introduced through PMCR RWPs.

[6] *Victorian Cladding Taskforce Report from the Co-Chairs*, July 2019

4 Cladding and the risk to building occupants

> Building occupants face risk not only from the cladding on the facade but also from delay and uncertainty in deciding how to make their buildings safe.

Cladding Safety Victoria was established because of concern about catastrophic outcomes associated with facade fires on buildings with combustible cladding.

Since 2019, the primary focus of CSV activity has been to identify those buildings where cladding presents the highest risk and to fund rectification projects focused almost exclusively on the removal of cladding. That is, reducing cladding risk by removing the cladding fuel with the potential to feed facade fires.

Overall, CSV has identified and approved funding to remove combustible cladding from 366 buildings with an unacceptable cladding risk.

There are several hundred buildings that remain in CSV scope and await a mitigation solution that responds to the risk associated with cladding on their facades.

The figure below illustrates how the remaining CSV buildings that await a solution compare to the iconic high-rise buildings at which cladding gave rise to large scale fires, horrific consequences (in some cases) and appropriately prompted a response from governments world-wide.

The buildings that drew attention to the risk of combustible cladding are nothing like the majority of buildings that for which solutions will be required using the PMCR.

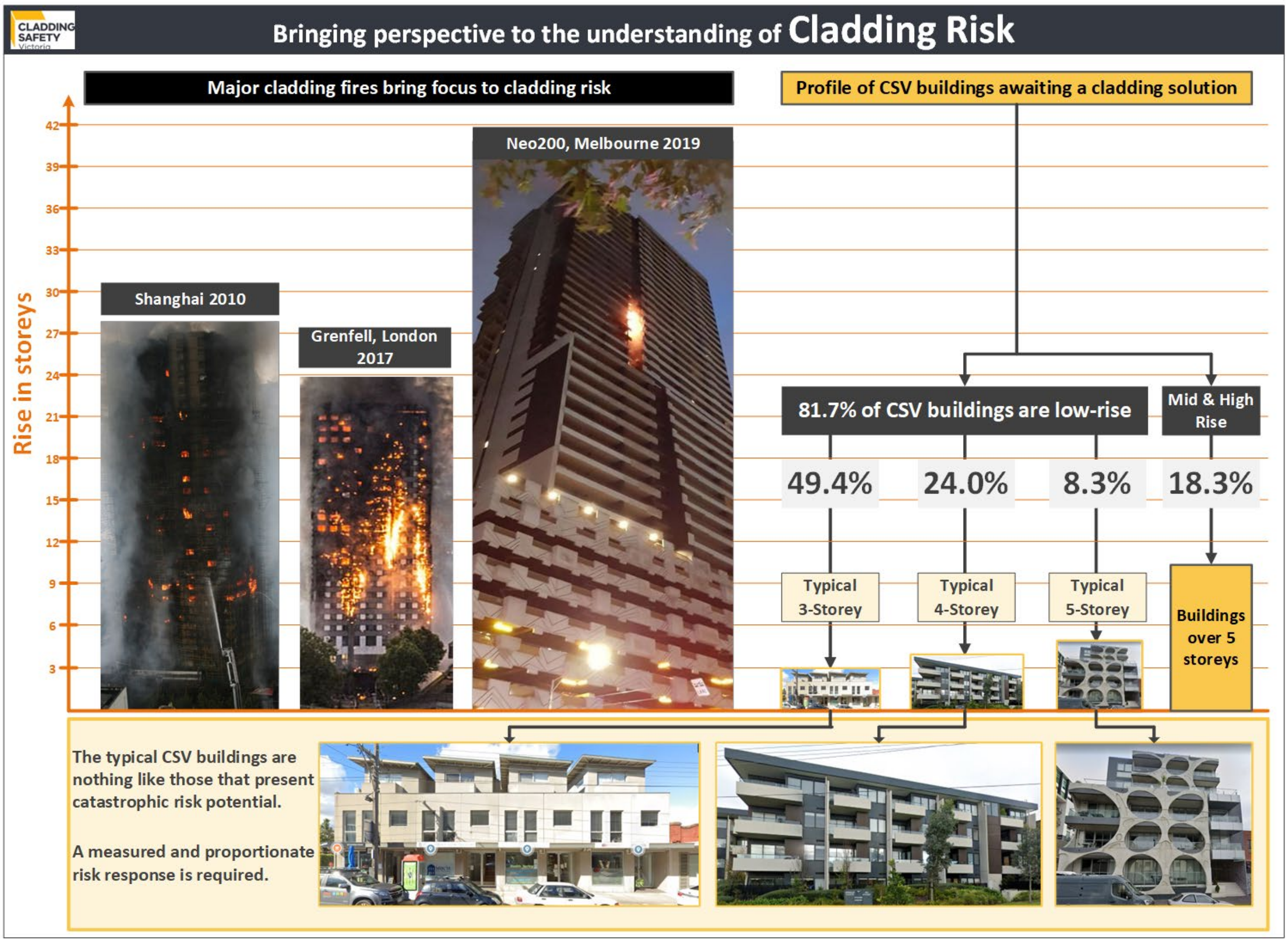


Figure 1: CSV Class 2 buildings – bringing a risk perspective to cladding to risk assessment and mitigation

The PMCR is designed to deliver a risk appropriate response to cladding, in which the effort in delivering a remedy (cost and complexity) is proportionate to the threat to life safety posed by the cladding.

4.1 Cladding risk rating

In December 2020, CSV introduced the Cladding Risk Prioritisation Model (**CRPM**), developed in collaboration with the Commonwealth Scientific and Industrial Research Organisation (**CSIRO**) Data61 during the second half of 2020.

The CRPM improved on the previous risk triaging method for prioritising cladding remediation works in that it gave primacy to facade fire spread via cladding, consistent with CSV's focus on combustible external cladding. The CRPM introduced a new measure, the Initial Fire Spread in Cladding Assessment Number (**IF-SCAN**).

The IF-SCAN is a measure of:

"The number of apartments[7] (or SOUs) that would be directly impacted under a worst-case scenario by a fire that ignites and spreads in combustible cladding prior to the first suppression response by firefighting agencies."
Source: Cladding Risk Prioritisation Model: A method for assessing combustible cladding risk on Victorian residential Class 2 buildings, August 2020

The IF-SCAN focuses on how cladding connects dwellings (sole occupancy units or **SOUs**) and gives primacy to the threat to building residents, consistent with the NCC focus on life safety.

The other key design feature of the CRPM is a recognition that cladding risk is substantially mitigated when a building has an automatic sprinkler system that includes sprinkler installations in SOUs (recognising that most fire incidents originate in living spaces).

Using the IF-SCAN rating in combination with knowledge of sprinkler protection, CSV has used the CRPM to allocate each building to one of three cladding risk rating categories.

The Victorian Government has adopted CSV's CRPM cladding risk rating scheme as the risk triaging method for combustible external cladding under its Cladding Risk Mitigation Framework, which codifies the three cladding risk rating categories in Victorian state policy, as defined in Table 1.

Table 1: Cladding risk rating categories

	Risk description	
Cladding risk rating category	**Sprinkler protected**	**Not sprinkler protected**
Unacceptable	Risk of fire spread across the combustible external cladding of **≥ 4 SOUs**	Risk of fire spread across the combustible external cladding of **≥ 3 SOUs**
Elevated	Risk of fire spread across the combustible external cladding of **3 SOUs**	Risk of fire spread across the combustible external cladding of **2 SOUs**
Low	Risk of fire spread across the combustible external cladding of **≤ 2 SOUs**	Risk of fire spread across the combustible external cladding of **≤ 1 SOU**

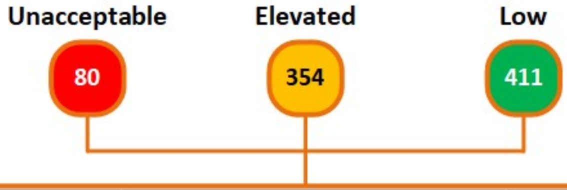
Source: Cladding Risk Mitigation Framework, Department of Transport and Planning, August 2023

[7] CSV is able to access information about the number of primary dwelling units in each building, referred to as Sole Occupancy Units (SOUs), and via access to architectural plans and elevations is able to relate SOUs to the location of cladding.

The CRMF and an associated Minister's Guideline provide the authorisation for the adoption of this cladding risk rating scheme and its application in the development of PMCR solutions to treat cladding risk on Victorian Class 2 and Class 3 buildings.

CSV has been systematically assessing the cladding risk on hundreds of Victorian buildings and developing a risk profile of the population of Victorian buildings with combustible external cladding. This work is ongoing, and will continue to be updated as product testing and due diligence inspection work is completed.

As of 21 November 2023, there were 845 Class 2 buildings that had been identified as having cladding incorporated in their facade design and which will require a targeted risk mitigation response through the application of the PMCR. The risk profile of this pool of buildings is shown in Figure 2 below.



IF-SCAN Value	Sprinkler Protected		Grand Total
	Yes	No	
0	89	48	137
1	37	59	96
2	178	308	486
3	46	18	64
4	14	18	32
5	6		6
6	8	5	13
7 or more	9	2	11
Grand Total	387	458	845

Figure 2: CRPM cladding risk rating applied to CSV Class 2 buildings

This risk profile illustrates that:

- 80 of the buildings (9.5%) carry an unacceptable level of cladding risk, and these buildings remain the focus of CSV funded cladding rectification works;
- The remaining 765 buildings (90.5% of the building population) have a lesser level of cladding risk (low or elevated), for which a risk proportionate response under the PMCR will be required; and
- Almost half (45.7%) of these Class 2 buildings benefit from existing sprinkler protection that extends to SOUs.

This CSV Cladding Risk Policy is designed to ensure that the design of PMCR solutions reflect the significant benefits to life safety provided by sprinklers, as is demonstrated through the research findings presented in section 5 of this document.

4.2 Cladding and occupant well-being

The prevailing risk focus adopted in response to combustible external cladding is an engineering perspective that considers the potential for physical injury related to fire ignition and spread dynamics. Under this risk frame of reference, the concern is on the deaths or injuries that may result in a building fire scenario where the extent and rate of fire spread is exacerbated by the presence of cladding on the building facade.

It is imperative that cladding risk continues to be evaluated and understood from a fire engineering perspective and that evidence is furnished to substantiate investment in solutions to mitigate cladding risk in the context of credible threats to life safety.

While this focus on fire related threats to life safety is entirely relevant, it is important to also consider another set of risk factors facing building occupants. These “other” risk factors are associated with the mental health and well-being of the occupants of buildings who live with uncertainty about: the degree of risk they face due to the presence of cladding on their building; the solutions that are required to resolve cladding issues; the cost of resolving cladding issues; and an awareness of what support is available to them.

The development, authorisation and activation of the PMCR under the Victorian Government’s Cladding Risk Mitigation Framework is intended to address consumer uncertainty about cladding risk, the extent of risk mitigation action required (if any) and the support that is available to assist building occupants.

Through its extensive engagement program with building owners over four years of operation, CSV has gained firsthand insights into the anguish and disruption to life that building owners and occupants face due to uncertainty about what needs to be done with the cladding on their buildings.

Two recent studies have been undertaken that review the impacts and mental health issues of the people living in buildings that have cladding.

1. **Oswald, D., Moore, T. and Lockrey, S. (2021) *Flammable cladding and the effects on homeowner well-being*.**

   This study was undertaken in Australia and used a technique of semi-structured interviews with 16 homeowners living with cladding, 13 of whom live in Victorian buildings. A key purpose of this research was to address a gap in knowledge, as stated in the research article:

   “Little existing research has considered how the rise in flammable cladding on properties has affected homeowners in terms of housing quality, liveability, and well-being. This study aims to close this gap in knowledge by providing insights into the lives of those that own residences with flammable cladding.”

2. **Martin, W. and Preece, J. (2021) *Understanding the impacts of the UK ‘cladding scandal’: Leaseholders’ perspectives*.**

   The authors, from the United Kingdom Cladding Action Group (**UKCAG**) and the University of Sheffield, present the findings of a survey of 550 people living in 143 private buildings in 45 UK council areas that reside in buildings found to have combustible cladding on their facades:

   “This focus article presents the key findings from research conducted by the UK Cladding Action Group (UKCAG) into the mental health impacts of living in a building affected by flammable cladding and/or other fire safety defects. The full results were published in the report UKCAG Cladding and Internal Fire Safety Mental Health Report 2020.”

Together these research pieces provide both quantitative and qualitative insights into the impacts on building owners that arise through living with cladding, particularly over an extended period of time and where there is a high degree of uncertainty about the pathway to resolving their cladding issues.

The extent of adverse impacts on occupant well-being and the severity of those impacts is demonstrated through the summary findings of the UKCAG research.

Key survey findings

As a direct result of the presence of external combustible cladding on the buildings where they live:

- 90 per cent said their mental health had deteriorated.
- 23 per cent reported having suicidal feelings or a desire to self-harm.
- 71 per cent reported having difficulty sleeping.
- 94 per cent said they were suffering from worry and anxiety.
- 60 per cent used coping strategies to deal with their situation.
- 35 per cent said that existing physical and mental health conditions had been exacerbated.
- 84 per cent said they cannot move on with their lives.
- 58 per cent of people had concerns about seeking help or treatment for mental/physical health problems caused by their situation during the pandemic.

Source: Understanding the impacts of the UK 'cladding scandal': Leaseholders' perspectives, Martin and Preece, 2021

These findings suggest that the threat to life safety does not only derive from the fire threat posed by cladding, but also from the failure and delay in providing a response to combustible cladding.

The Australian study provided insights closer to CSV's own experiences with building owners/occupants, being focussed on buildings that have been subject to the initial risk-based screening conducted through the State-wide Cladding Audit (**SCA**) using the Risk Assessment Tool (**RAT**) developed by the Department of Environment, Land, Water and Planning (**DELWP**)[8].

Knowledge of the RAT based risk assessments, allowed the researchers to evaluate how the well-being of interview respondents varied under different risk scenarios.

"The emotions that participants felt were dependent on the risk level of the building, their financial situation, and current mental state. The emotions related to the potential costs including frustration, anxiety, anger, disappointment, and fear of not being able to afford the payments. Some homeowners also felt very unsafe in their own homes, particularly in higher risk buildings, or those that had experienced close calls with fire already."
Source: Flammable cladding and the effects on homeowner well-being, Oswald, Moore and Lockrey, 2021

While a number of owners expressed feeling unsafe in their homes due to the presence of combustible cladding, one interviewee that faced a low level of cladding risk expressed frustration at the cost and burden placed upon them to deal with the cladding.

"The risk levels on the building also influenced on stress levels. For example, one low-risk building had only four small flammable panels that covered doors to prevent people getting wet. The homeowner in this case was not stressed about safety, but frustrated at the cost to remove these panels."
Source: Flammable cladding and the effects on homeowner well-being, Oswald, Moore and Lockrey, 2021

This observation impresses upon CSV (and others that share an interest in making buildings with cladding safe) the importance of explaining risk assessments and accurately reflecting the level of risk faced by building occupants and the risk mitigation actions (if any) that building owners should be required to invest in. This vital risk consideration is the foundation of the PMCR design.

The research discussed in this section shows that the impacts on building owners have multiple dimensions and are significant, impacting both individual health and the life choices of people, which are evidently constrained by the presence of cladding on the buildings in which people live.

[8] Cladding Risk Assessment Tool Guidance, DELWP, May 2018

Flammable cladding affected homeowners in different ways. Those in lower-risk buildings and more financially stable were frustrated with uncertain costs and processes involved with removal; but were less impacted than those in higher-risk buildings, who faced greater financial uncertainty and safety concerns. These concerns and uncertainty were manifesting in cost-saving behaviours and impacting on short- and longer-term life plans such as delaying retirement. In addition, homeowners were left feeling unimportant, unheard and helpless in the process. They risked social tensions with neighbours and owners' corporations in trying to solve the cladding issues, and lost their right to access apartment complex facilities, amenities and the use of their own barbeque. While previous studies have explored the potential costs involved in rectification works, this paper reveals that the flammable cladding issue is about more than the financial impacts, with significant well-being impacts of effected homeowners.

Source: Flammable cladding and the effects on homeowner well-being, Oswald, Moore and Lockrey, 2021

The impact on life choices and life transition was a prominent theme in the UK study also.

As a result of the ongoing uncertainty over the financial liabilities they may face, as well as the day-to-day realities of living in an unsafe building, many individuals used their response to tell their own stories of life plans derailed. Life transitions are often tied up with home transitions, as well as a sense of financial security and control that facilitates making significant life decisions. The pervasive sense of uncertainty over the cost of – and responsibility for – remedial works meant that this sense of control and stability was absent, as well as rendering properties unsaleable.

Many respondents noted that their plans to have children had been affected by the uncertainty they faced, and this had emotional and mental health consequences.

Others emphasised that they did not feel able to start a family because of the safety issues, questioning 'how can we bring a child into the world when we live in a one bed flat at the top of what we now know to be a matchstick?' (R39). In addition to being unable to have children, other individuals reported disruption to life transitions such as relocating to a larger home as households expanded, getting married, being unable to move to take up jobs or to facilitate caring for other relatives, and revising plans for retirement due to the potential bills they faced.

Source: Understanding the impacts of the UK 'cladding scandal': Leaseholders' perspectives, Martin and Preece, 2021

A recurrent theme identified in both the Australian and United Kingdom studies was the issue of homeowner uncertainty that existed in relation to cladding and the implication that uncertainty has for owner well-being.

"In part, these feelings stemmed from lack of control over the problems individuals faced, and uncertainty over how and when they could be resolved. At the point of the survey, respondents had been living with these issues for nearly three years, and yet many still had little information about the costs of remedial works, who would be liable, what support may be offered, and when this situation would be resolved.

The combination of danger, loss of sleep, uncertainty, loss of control, and potential for huge bills for remedial work combined to create an atmosphere that was severely damaging for the mental health of residents."

Source: Understanding the impacts of the UK 'cladding scandal': Leaseholders' perspectives, Martin and Preece, 2021

CSV has long recognised that the Victorian Government's cladding rectification work that is being undertaken under CSV administration has a significant social policy dimension, and is not simply a materials-based infrastructure project. In the 2020-21 Cladding Safety Victoria Annual Report, CSV said:

"While the cladding rectification program has the appearance of being a capital bricks and mortar program, it is inevitably a social program that must continue to find ways to support ordinary people in dealing with a problem of substantial complexity and significant cost."

CSV's development of the PMCR and the Victorian Government's authorisation of its use is timely, as the cladding risk mitigation focus shifts from rectifying buildings with an unacceptable cladding risk to designing solutions for buildings with lower levels of cladding risk.

In delivering PMCR solutions, CSV will work in a way that assuages psychological stressors that are impacting on individual well-being by:

- Providing clear evidence-based information about how to understand cladding risk;
- Demonstrating how active and passive building safety features (like sprinklers) make buildings significantly safer for occupants and substantially reduce the need for expensive and unnecessary rectification work; and
- Advocating that those that may still demand a compliance driven ‘remove cladding at all costs’ view that the obligation is on them to evidence to owners why owner investment in substantial rectification work is necessary.

CSV will continue to support cladding removal as a primary response on unacceptable rated buildings. However, this approach, when taken, must be substantiated on risk-based grounds by those requiring it.

5 Research into the benefits of sprinkler protection

Cladding Safety Victoria has reviewed international research and fire incident data to answer two specific questions about fire safety in sprinkler protected buildings:

1. To what extent does sprinkler protection in a building improve safety?; and
2. Under what cladding scenarios is a sprinkler protected building sufficiently safe to allow for cladding to be substantially retained?

A sprinkler protected building where cladding on a facade connects 13 SOUs is as safe for occupants as a non-sprinklered building with no cladding.

The CSV literature review and analysis relies primarily on United States research undertaken under the auspices of the National Fire Protection Association (**NFPA**)[9]. The use of NFPA data and analysis was appropriate because:

- The installation of residential sprinkler systems across a wide range of US buildings has been a requirement of US fire safety regulation for over 20 years;
- Highly detailed, systematic and consistent data is captured about structure fire incidents;
- The fire incident data available in the US allows for comparisons to be made between:
  - ✓ Sprinkler protected and non-sprinkler protected buildings; and
  - ✓ Single and multi-dwelling structures (such as apartment buildings);
- The volume of incident data is extensive, capturing details of 344,900 structure fires in the five-year period from 2015 to 2019 that accounted for 2,616 civilian deaths and 11,036 civilian injuries; and
- There is an absence of equivalent Australian fire incident data to enable the benefits of sprinklers for life safety to be evaluated in an Australian context.

Similarly rich and comprehensive data is available for Canada, with 200,000 structure fire incidents the subject of detailed research undertaken by the University of the Fraser Valley[10]. The Canadian research provided additional insight and a point of reference and comparison for conclusions drawn on the basis of US data.

The detailed literature review and analysis undertaken by CSV is captured in the report, *D.05.01Support Package – Sprinkler Protection*, and is further analysed in the collaborative paper titled "*A Risk-based Approach to Assess the Effectiveness of Sprinklers in Buildings with Combustible Cladding*[11]".

The research undertaken by CSV is designed to inform a CSV cladding risk policy position on how to develop risk proportionate responses to cladding risk under the PMCR for buildings with sprinkler protection.

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[9] *US Experience with Sprinklers*, NFPA, October 2021

[10] *Fires that Commence on Balconies of Multi-Residential Buildings: Analysis of the National Fire Incident Database*, University of the Fraser Valley, June 2019

[11] *Pedersen K, Nguyen K, Hunt A. A Risk-Based Approach to Assess the Effectiveness of Sprinklers in Buildings with Combustible Cladding. Fire. 2025; 8(4):119. https://doi.org/10.3390/fire8040119*

5.1 Sprinkler protection: the facts

The headline facts about sprinkler protection are evidence based and compelling.

Ignition Source	Sprinkler reliability	Fire containment	No. of deaths	Firefighter injuries
90%	95%	97%	-88%	-78%
of fires start internally	of sprinklers operate efficiently and reliably when called into action	of fires in a sprinklered building are confined to the room of origin	lower per 1,000 fires in sprinklered buildings compared to a non-sprinklered buildings	lower per 1,000 fires in sprinklered buildings compared to non-sprinklered buildings

From a life safety perspective, it is important to consider both **individual risk** (i.e. impacts of ignitions on individuals directly linked to the ignition cause/location) and **societal risk** (i.e. impacts to other people that had no association with the ignition cause/location).

From a CSV cladding risk perspective:

- **Individual risk** – is represented by the risk to persons associated with the SOU of fire origin; and
- **Societal risk** – is represented by the risk to persons associated with other SOUs beyond the SOU of origin, due to the spread of fire via cladding.

The diagram below summarises how the risk (both individual and societal) of adverse cladding fire events are perceived for the purposes of this policy in sprinkler protected buildings.

Risk	Internal Fire (kitchen, bedroom, living, etc)	External Fire (ground and balcony)
	90% of ignitions	10% of ignitions
Individual Risk	• Highly likely to be suppressed in room of origin • Sprinkler suppression provides increased time and opportunity for occupants to egress safely	• If an external fire breaches an SOU, the fire is highly likely to be suppressed by SOU sprinklers. • Sprinkler suppression provides increased time and opportunity for occupants to egress safely
Societal Risk	• Highly likely to be suppressed in room of origin • Highly unlikely to flashover and reach external cladding • If reaching cladding, highly likely to to be suppressed in 2nd and subsequent SOUs	• If an external fire breaches an SOU, the fire is highly likely to be suppressed by SOU sprinklers. • Sprinkler suppression provides increased time and opportunity for occupants to egress safely

The significant demonstrated benefits that sprinklers provide for occupant safety raise legitimate questions about what needs to be done with cladding on a building facade when sprinkler protection is in place. This matter is the subject of the following section.

5.2 Cladding removal in sprinkler protected buildings

CSV's risk assessment method, through the design and application of the CRPM, recognised that the occupants of a building that is sprinkler protected are safer than the occupants of an equivalent building that is not sprinkler protected. Conservative IF-SCAN thresholds were initially set by CSV to represent the difference in risk for sprinkler protected buildings and non-sprinklered buildings. These thresholds are now reflected in the *Cladding Risk Rating Categories* in the Victorian Government's Cladding Risk Mitigation Framework (see section 4.1 of this document).

To support the design and development of the PMCR, CSV has initiated and sponsored research to extend its understanding of cladding risk and to define and calibrate cladding risk assessments and the design of RWPs.

A key area of CSV research activity brings together:

- international research and fire incident data relating to the safety benefits of sprinkler protection; and
- CSV's own understanding of cladding risk, developed over four years.

The findings of the CSV research are provided in the report *D.05 Support Package – Sprinkler Protection*.

The CSV research into sprinkler protection provides four core streams of information relevant to the development of this CSV Cladding Risk Policy:

1. Defining **benchmarks** (based on the IF-SCAN) for determining when a building with sprinkler protection is deemed acceptable' to retain cladding in situ;
2. Analysis of the reduction in **deaths and injuries** that result for a fire in a sprinkler protected building (compared to a non-sprinklered benchmark building);
3. Analysis of the reduction in **property loss** that result from a fire in a sprinkler protected building (compared to a non-sprinklered benchmark building); and
4. Observations about the need for different responses to cladding risk mitigation where **cladding is located on a facade high above the ground** in significant volumes.

Each of these subjects is covered in a separate sub-section within this document.

Benchmarks for cladding retention

Under the *Cladding Risk Mitigation Framework*, a building has a cladding risk rating of **low** when it is:

- sprinkler protected and has an IF-SCAN[12] between 0 and 2; or
- not sprinkler protected and has an IF-SCAN between 0 and 1.

A key design principle of the PMCR is that buildings with a rating of **low** do not require cladding removal, except for targeted removal designed to enhance safe access to or egress from a building where unduly compromised. These buildings are considered 'sufficiently safe' to allow all or most cladding to remain, consistent with the PMCR approach (see Appendix B: PMCR threat barrier approach).

The policy principle is that where a sprinkler protected building with cladding can be demonstrated to be as safe as a non-sprinklered building with a cladding risk rating of low, the case for substantial cladding retention has been established.

The benchmark:	The benchmark building for the CSV analysis is a non-sprinklered building with an IF-SCAN of 0. To allow cladding retention on sprinkler protected buildings, it is necessary to demonstrate that a building at each ascending IF-SCAN score (3 and above) is as safe (from a death and injury perspective) as a non-sprinklered low rated building with an IF-SCAN of 0 (zero).

Analysis – deaths and injuries

The CSV research considered how sprinklered buildings (at different IF-SCAN levels) compared to a benchmark non-sprinklered building (low rated IF-SCAN 0 building – see above).

The CSV comparative analysis estimated how expected death and injury rates would likely vary for buildings with cladding at different IF-SCAN levels compared to the benchmark building[13].

The NFPA analysis of fire incident data for the five-year period 2015-2019 was used for these calculations. The NFPA analysis develops risk insights based on 344,900 (100%) structure fire incidents, comprising:

- 318,500 (92%) fire incidents in buildings where there were no automatic extinguishing systems (**AES**) present; and
- 25,000 (7%) fire incidents where AES were present, including 23,600 where a sprinkler system was present (and 21,000 of those with a wet pipe sprinkler system, which were the focus of the CSV comparative analysis of deaths and injuries).

The CSV analysis evaluated how the rate of death and injury varied from both an individual risk and a societal risk perspective, consistent with the accepted standard for considering life safety.

The CSV analysis was undertaken in two parts:

1. Quantify the difference in adverse impacts (**consequence**) for life safety when a sprinkler protected building is compared to a non-sprinklered building (independent of cladding); and
2. Quantify the change in life safety risk that result from a change in ignition/fire spread probability (**likelihood**) due to the presence of combustible cladding on a building facade.

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[12] The IF-SCAN provides a measure of the number of SOUs connected by cladding that runs continuously across a building facade.

[13] It should be noted that very conservative assumptions of cladding fire spread were adopted for the CSV analysis. For example, the analysis assumed a 100% probability of upward vertical fire spread via cladding from the lower to upper SOUs and a 90% probability of downward vertical fire spread via cladding from the upper to lower SOUs (falling debris and dripping cladding).

Consequence

The adverse life safety impacts that fire safety strategies are designed to prevent or reduce are deaths and injuries amongst civilian populations and those fighting fires.

The CSV analysis therefore commenced with a review of civilian death and injury rates observed in home structure fire incident data available for the US for the five-year period from 2015 to 2019. The focus was on understanding how the rates of death and injury vary for fires occurring in sprinkler protected buildings compared to those fire events occurring in non-sprinklered buildings.

While death is a discrete, final and unequivocal adverse outcome of fire, injury is not. Injuries can vary substantially in severity and so the CSV analysis of injuries focused not only on injury rates, but also on injury severity. A 2012 study of injury severity conducted in the US stated in its introduction:

"A death is a death and a dollar of property damage is a dollar, but there are great variations in injury severity and in the associated costs of injury. The hypothesis was that, by making fires smaller, sprinklers might reduce not only the frequency of injuries but also the average severity of injuries when they occurred.

The model was used to examine sprinkler impact on injuries per 100 fires and on injury costs per 100 fires. Cost data was available on (a) medical costs, (b) legal and liability costs, which are typically quite small, (c) costs associated with lost work time, which are typically of the same order as the medical costs, and (d) pain and suffering costs, which tend to dominate the total and are based in large part on analysis of jury awards. Sprinkler impact was estimated for total injury costs – the combination of (a) through (d) – and for medical costs alone."

Source: Sprinkler Impact on Fire Injury: Final Report, Fire Protection Research Foundation, October 2012

The **key statistics** about structure fires and sprinkler protection are shown in Figure 3.

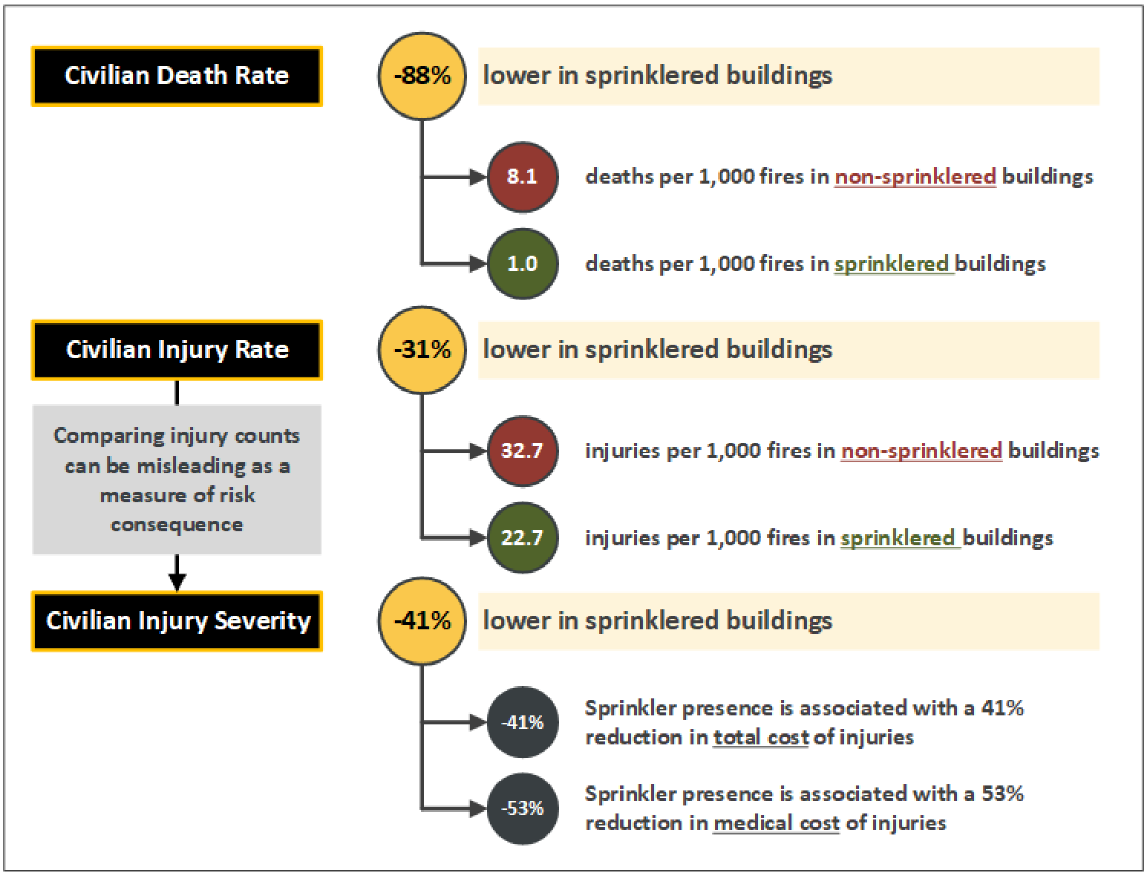

Figure 3: NFPA headline statistics about sprinkler protection and the benefits to life safety

Sources: US Experience with Sprinklers, NFPA, October 2021 and Sprinkler Impact on Fire Injury: Final Report, Fire Protection Research Foundation, October 2012

Likelihood

While the availability of sprinkler protection makes a quantifiable difference to the risk profile of a building, the presence of combustible cladding also impacts a building's risk profile.

The second part of the CSV analysis was therefore focussed on evaluating how different quantities of cladding on a facade (as measured by the IF-SCAN) change the risk profile of a building by increasing the likelihood of a fire igniting the facade and spreading via cladding to one or more SOUs.

The key observations/assumptions that drove the assessment were:

Fire origin	Fire origin comprises: ▪ 90% that start inside a building; and ▪ 10% that start externally (ground and balcony fires).
Internal fires igniting cladding	Only 3% of internal fires will break out (flashover) and reach cladding, assuming: ▪ 97% of fires in a sprinkler protected building do not leave the room of origin; and ▪ 100% of flashovers from inside will reach and ignite cladding.
External fires igniting cladding	100% of external fires will ignite cladding.
Fire spread between SOUs	For any continuous vertical run of cladding connecting SOUs, it is assumed that: ▪ 100% of the time the cladding will carry fire to all SOUs located above the SOU of origin; and ▪ 90% of the time the cladding will carry fire to all SOUs located below the SOU of origin.
Breach of SOU from external fires	Only 5% of external fires may cause harm to a person inside an SOU from a cladding fire, based on the assumption that: ▪ 95% of the time sprinkler systems operate efficiently and reliably to suppress fire.

The assumptions that drive CSV's analysis are very conservative, increasing the confidence that the conclusions reached about the relative safety of sprinkler protected buildings are defensible.

Conclusion[14]

Using the data observations and assumptions relating to fire consequence and likelihood discussed above, the CSV analysis was able to compare the risk profile of:

- Sprinkler protected buildings with different levels of cladding risk exposure (as indicated by the IF-SCAN score); to a
- Benchmark non-sprinklered building – a building without a threat from cladding to SOUs (i.e. an IF-SCAN of 0).

The benchmark building was deemed to have a benchmark risk of 1 or 100%.

A risk weighted value was then calculated for sprinkler protected buildings at each IF-SCAN score. Where the calculated value is:

- Below 100%, the sprinklered building is considered to have a lower risk than the benchmark building;
- Equal to 100%, the sprinklered building is considered to have an equivalent risk to the benchmark building; and
- Above 100%, the sprinklered building is considered to have a higher risk than the benchmark building.

Up to IF-SCAN 17, sprinkler protected buildings are safer than the benchmark building for civilian deaths.

Up to IF-SCAN 13, sprinkler protected buildings are safer than the benchmark building for civilian injuries.

[14] The conclusions are drawn on the basis of the findings in relation to individual risk (not societal risk), where the ability to "beat" the benchmark is more difficult.

Analysis – property loss

Cladding risk mitigation strategies are overwhelmingly driven by life safety considerations.

However, structural fires also have financial impacts and any assessment of fire consequences would be incomplete without consideration of the costs of fire.

An interesting dimension of the analysis is the incorporation of research undertaken in the US, which evaluated how the costs of fire reduce in sprinkler protected buildings (compared to non-sprinklered buildings) across three categories of fire related cost.

The US research based on 350,000 reported home structure fires between 2006 and 2010, reported that the savings ($US, 2012) are significant in all three cost categories (as illustrated in Figure 4).

Figure 5 better reflects the relative benefits of sprinklers by expressing average costs per fire in a sprinkler protected building to that for a non-sprinklered building.

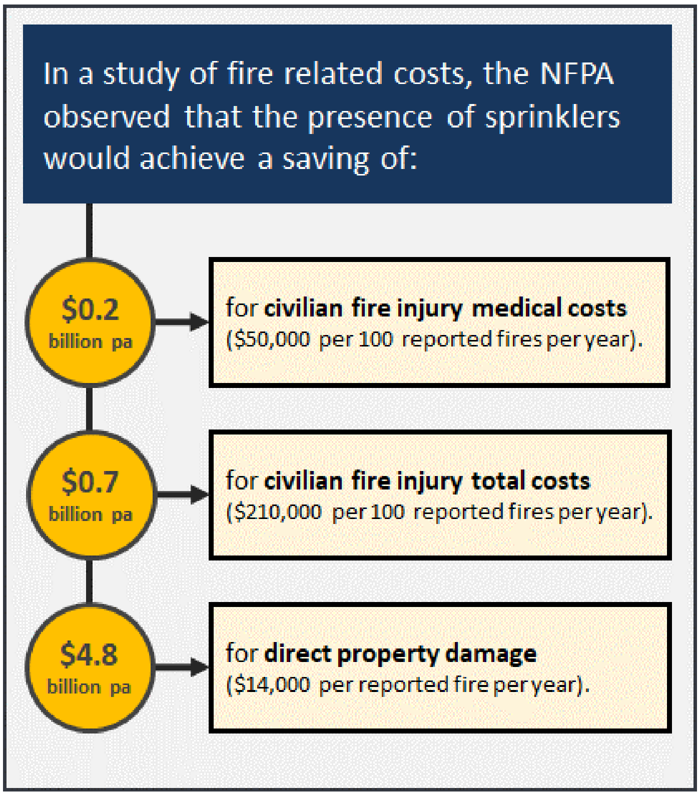

Figure 4: Estimated annualised cost savings for sprinkler protection ($US, 2012)

Source: Sprinkler Impact on Fire Injury: Final Report, Fire Protection Research Foundation, October 2012

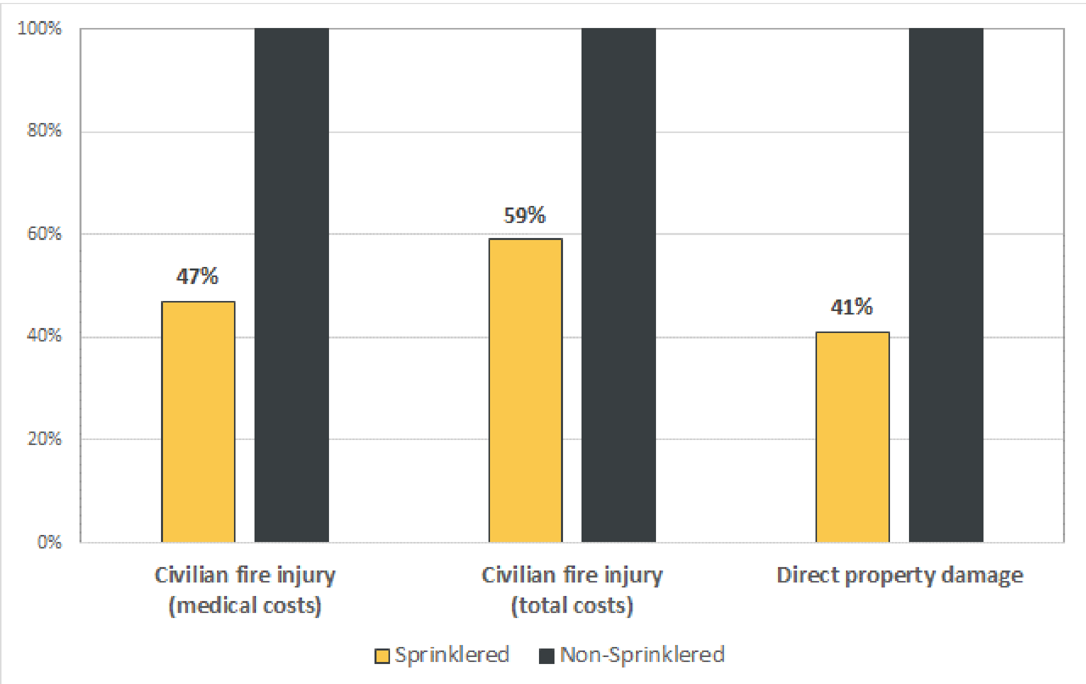

Figure 5: Ratio of cost per fire for a sprinkler protected building compared to a non-sprinklered building

Source: Sprinkler Impact on Fire Injury: Final Report, Fire Protection Research Foundation, October 2012

Similar research findings have been referenced within Australian regulatory documents about the cost advantages of residential sprinkler systems. The Regulatory Impact Statement (**RIS**) that the Australian Building Codes Board (**ACBC**) released ahead of the 2019 changes to the National Construction Code noted:

"In 2017, a contemporary analysis by the U.S National Fire Protection Association (NFPA) into the effects of fire sprinklers reducing property loss revealed that of 356,000 fires that occurred between 2010 and 2014, average losses reduced from $19,301 per fire to $8,100 where fire sprinklers were present.

…

This equates to a 58% reduction in property loss where fire sprinklers were installed."
Source: Fire safety in new Class 2 and Class 3 residential buildings Regulation Impact Statement for decision, ACBC, 2018

This shows that the savings provided by sprinklers in relation to direct property damage have remained consistent over almost a decade of home structure fire incidents.

CSV has also completed analysis of property loss by benchmark comparison, using NFPA fire related property loss data for 2015-2019 and the same approach used for the analysis of civilian deaths and civilian injuries.

Up to IF-SCAN 7 sprinkler protected buildings have lower direct property damage costs than the benchmark building.

Analysis – fighting fires at height

Quantitative assessments of death, injury and property damage cannot account for all risk considerations associated with preventing (where possible) and suppressing a fire.

Certain fire scenarios accentuate the life safety risks for building fires beyond that computed in general analyses and models. Significant risk escalating scenarios need to be identified and considered in the design of risk mitigating solutions that respond to cladding fire risk, like those being developed for use through the PMCR.

Melbourne's own contemporary experience of cladding facade fires encompasses:

- the 2014 Lacrosse fire, where a balcony fire spread via the facade from the 8th floor down to the 6th and up to the 21st floor (16 levels); and
- the 2019 Neo200 fire, where a balcony fire spread via the facade from the 22nd to the 29th floor (8 levels).

These experiences provide invaluable insights into the optimal design of risk proportionate responses under the PMCR.

The Melbourne Fire Brigade (**MFB**) *Post Incident Analysis Report* for the 2014 Lacrosse fire provided a couple of crucial insights relevant to this policy.

Sprinkler effectiveness	**Fighting fires at height**
In total, 26 fire sprinkler heads activated over 16 floors during the fire incident. As the fire spread to each level, fire sprinkler heads generally activated within the lounge and bedroom 2 and prevented internal fire spread and development into apartments. This put a significant demand on the installed sprinkler system and associated water supply. Additionally, two internal fire hydrants were used by fire-fighters to extinguish fires not extinguished by the sprinklers. The installed combined fire hydrant/fire sprinkler system, compliant with AS2118.6 . . . **it is reasonable to conclude that the system operated significantly beyond its designed capability.**	The fire resulted in internal ignition occurrences on all floors where external fire spread occurred. **Simultaneous fire incidence over many floors at heights possibly well beyond the external reach capabilities of the attending Brigade, is an extremely challenging scenario for successful Fire Brigade intervention.** Based on the observations of the fire incident, the Chief Officer believes that the building solution does not incorporate elements to the degree necessary to avoid the spread of fire.

The MFB comment about the effectiveness of the sprinkler system shows that it was an important fire safety building feature that served to ensure safe evacuation and the avoidance of death and significant injury in the Lacrosse fire. Sprinklers also operated as designed in the Neo200 fire, functioning similarly to aid safe evacuation and avoid death and injury.

The analysis of these incidents provides a tangible Melbourne-centric perspective on the benefits of sprinklers that reinforce the observations and research findings of CSV represented in this document.

There is undoubtedly additional complexity and challenge in delivering a fire-fighting service to combat a fire and aid the safe evacuation of occupants where the fire started or has reached a height well above the ground. Understanding these complexities is important to the PMCR design as it applies to solution design in relation to combustible cladding located high on a building façade.

A detailed study of fires in residential buildings in England between 2010-11 and 2019-20 was undertaken to better understand the additional risks associated with fires in high-rise flats. The study's purpose is captured in the introductory part of the report:

"To address this evidence gap, we set out to explore what official fire incident data can tell us about the fire risks in blocks of flats, the possible role of building height and type, and the need for evacuation planning . . .

Our analysis specifically focused on exploring the possible relationships between different dwelling types and heights, the frequency of fire incidents, the floor of fire origin, the prevalence of delays to firefighting and unusual fire spread, the need for evacuations and rescues, and the risk of serious harm. We complemented this with evidence about the known risks associated with multi-occupancy residential buildings and high-rise blocks, and analysis of unusual and dangerous fires involving blocks of flats in the UK that we collated from various sources, to exemplify how various aspects of building design, construction, location, management and firefighting can contribute to increasing the risks from fire in such buildings."
Source: The Fire Risks of Purpose-Built Blocks of Flats: an Exploration of Official Fire Incident Data in England, S.Hodkinson and P. Murphy, July 2021

Some of the key observations made in the UK research that help to explain the accentuation of risk in fires occurring in high-rise buildings are:

- **Access and reach limitations**

  "*Timely intervention is far more challenging for blocks of flats primarily because the fire cannot normally be fought from the exterior of the building as service ladders and high-reach equipment have access and reach limitations."*

- **Establishment of a bridgehead**

  "*. . . FRS must enter the building to establish what is called a 'bridgehead', normally two floors below where the fire is, requiring the necessary equipment and personnel to be transported up the building. Where firefighting lifts are not installed, or are out of order, this has to be done via the stairs, adding more logistical difficulties, physical resources and time."*

- **Staging areas**

  "If the fire is at a *high* level, it may be necessary to establish one or more staging areas between the bridgehead and the ground floor*".*

Practical exercises were undertaken by the Hertfordshire Fire and Rescue Services (**FRS**) to determine the time required to deliver a firefighting service in a high-rise fire. The results demonstrate a significant delay, relative to national response time averages, in the commencement of suppression and evacuation activity, which increases the probability of fatality and injury in high-rise fires.

Following the deadly fire in 2005 at the 18-storey Harrow Court tower block in Stevenage that killed a resident and two firefighters, Hertfordshire FRS undertook a series of exercises designed to test and practise their procedures for dealing with high-rise fires. They concluded that it takes 20 minutes from arrival at the incident to establish a bridgehead with the resources required to deal safely with a fire on the upper floors.

Assuming an average national response time of 7.5 minutes, this points to an intervention point of 27.5 minutes for a block of flats, way past the 20-minute point at which the probability of fatality overtakes the probability of a successful rescue.

Source: The Fire Risks of Purpose-Built Blocks of Flats: An Exploration of Official Fire Incident Data in England, S.Hodkinson and P. Murphy, July 2021

Fire service response time

The PMCR method incorporates consideration of a reasonable expectation for fire brigade intervention to suppress a fire and support the safe evacuation of building occupants. The risk mitigation assessments of CSV assume that activity will occur in a timely fashion to suppress a fire in a building.

It is conceived that there is a veritable "golden window", a time period within which a fire can reasonably be controlled to limit harm to people and help limit property loss.

The Fire Rescue Victoria (**FRV**) service delivery standard for response time for all emergency incidents is 7.7 minutes[15].

Delays in fire services arriving at an incident and setting up equipment to commence suppression/evacuation activity:

- Decreases the probability of the successful rescue of all occupants; and
- Increases the probability of death and injury.

The UK research shows the relationship between the fire-fighting response time and the probability of fatalities, casualties and rescues (**FCR**). It shows that where it takes more than 20 minutes to respond to a fire, the probability of a fire related death exceeds the probability of safe rescue.

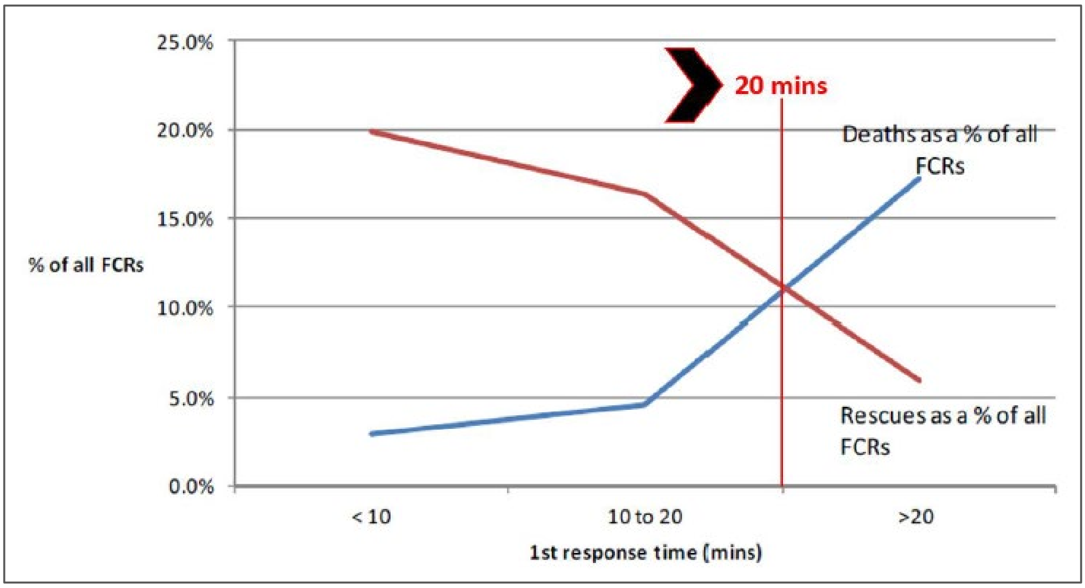

Figure 6: Percent of Fatalities, Casualties (all grades) and Rescues (FCRs) that die versus percent that are rescued, against response time

Source: The Fire Risks of Purpose-Built Blocks of Flats: An Exploration of Official Fire Incident Data in England, S.Hodkinson and P. Murphy, July 2021

Fighting a cladding fire at height demonstrably adds complexity and potentially delays the initiating of a fire-fighting response. This factor has been considered in the design of the PMCR.

[15] https://www.frv.vic.gov.au/sites/default/files/2023-03/Response-Times-Code1-table.pdf

Analysis – summary

This CSV research provides clear evidence to show that many sprinkler protected buildings with combustible cladding on their facades present less risk to life safety than an equivalent building with no cladding and no sprinkler protection.

On all measures that have been evaluated (civilian deaths, civilian injuries and property loss), sprinkler protected buildings with an IF-SCAN of 7 or below (i.e. where a continuous run of cladding makes it possible for a facade fire to spread between up to 7 SOUs) appear to reduce cladding risk to an acceptable level without the removal of cladding.

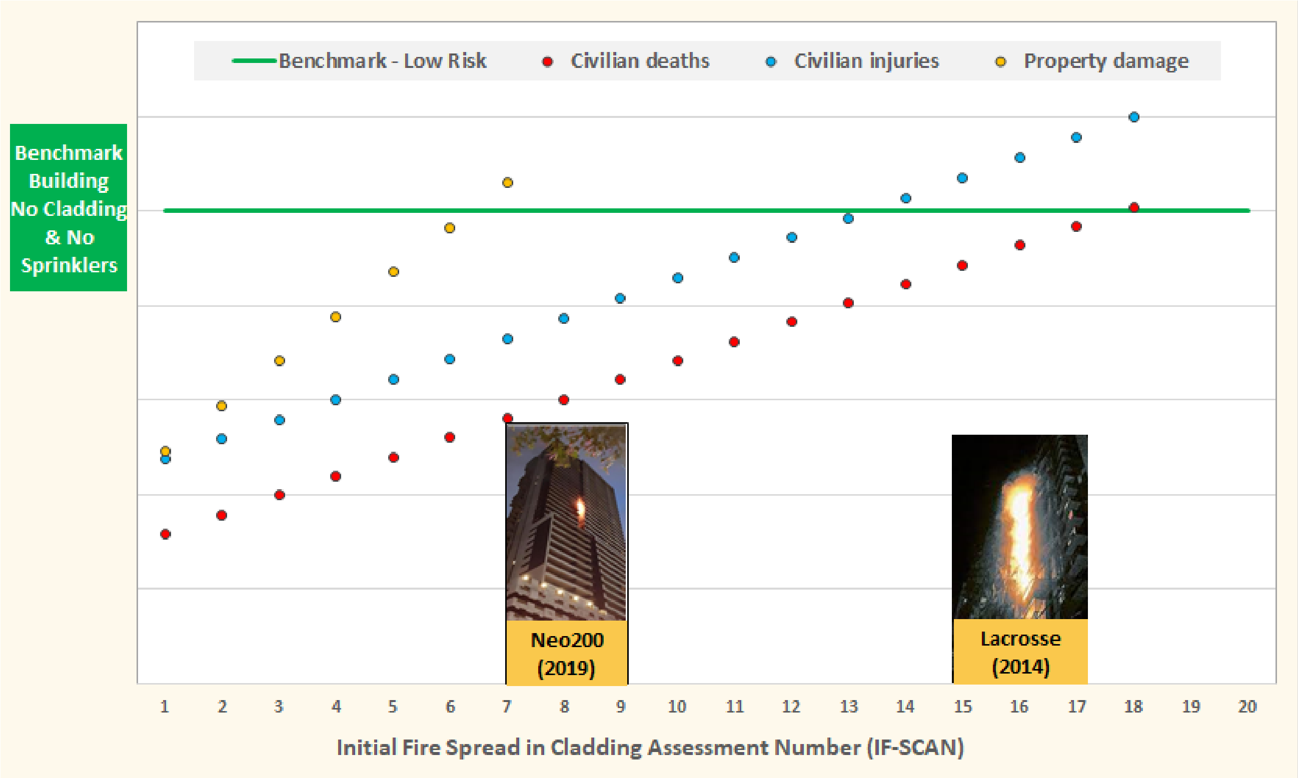

Figure 7: Benchmark comparison - buildings with cladding and sprinklers vs buildings with no cladding and no sprinklers

There will no doubt be exceptions to the general observation that cladding can remain. In situations where the likelihood of cladding fires is greater, the targeted removal of cladding material will need to be contemplated. The prescribed standards set out for the PMCR will identify these risk likelihood 'escalators' and the need for their consideration in designing and applying PMCR RWPs.

The other consideration that cannot be lost in framing a risk policy position for the response to cladding on sprinkler protected buildings is **community expectation**.

Melbourne has already had experience of significant facade fires that spread to multiple dwellings because of the cladding. While the 2014 Lacrosse fire and 2019 Neo200 fire are positive examples of sprinklers functioning as required to protect life safety, they are also examples of cladding facade fires that the Victorian community will not tolerate.

Despite the CSV analysis demonstrating the life safety benefits of sprinklers (against the non-sprinklered benchmark) up to an IF-SCAN level of 13, retaining cladding up to this level under a PMCR design would not pass the test of community expectation.

The CSV cladding risk policy position has, therefore, limited the general approach to cladding retention for sprinkler protected buildings to buildings with an IF-SCAN of 6 or below.

6 Sprinkler systems acceptable in a PMCR design

Once the risk benefit of existing sprinkler protection in buildings with cladding has been established, it is then reasonable to consider the opportunity to install residential sprinkler systems in those buildings with cladding that are not currently sprinkler protected.

To incorporate sprinkler installation interventions in the PMCR design, it is necessary to:

1. Identify those sprinkler systems that satisfy the requirements for their use in Class 2 and Class 3 buildings under the National Construction Code (**NCC**);
2. Establish their effectiveness in delivering the risk benefits sought under a PMCR solution design; and
3. Consider the practical implications and feasibility of retrofitting sprinkler systems in existing buildings.

These items provide the focus for discussion in this section.

6.1 NCC sprinkler requirements

The general provisions of the NCC stipulate that an automatic[16] sprinkler system should generally conform to the standard AS 2118.1 Automatic fire Sprinkler Systems – General Systems.

Special provision is made under the NCC for the use of automatic sprinkler systems in Class 2 and 3 buildings with an effective height of no more than 25 metres.

Specification 18: Class 2 and 3 buildings not more than 25 m in effective height in the NCC makes provision for the use of automatic fire sprinkler systems that comply with one of five standards:

- AS 2118.1 Automatic fire Sprinkler Systems – General Systems;
- AS 2118.4 Automatic fire sprinkler systems – Sprinkler protection for accommodation buildings not exceeding four storeys in height;
- AS 2118.6-of NCC 2022 Automatic fire sprinkler systems – Combined sprinkler and hydrant;
- FPAA 101D Automatic Fire Sprinkler System Design and Installation – Drinking Water Supply; and,
- FPAA 101H Automatic Fire Sprinkler System Design and Installation – Hydrant Water Supply.

Adherence to these standards is required for any PMCR solution that involves the installation of sprinklers.

6.2 Effectiveness of low-cost sprinkler systems

The introduction into the NCC of standards for automatic sprinkler systems based on drinking water and hydrant water supplies was enabled by the research conducted in 2017 jointly by Fire Rescue New South Wales (**FRNSW**) and the CSIRO.

The research was undertaken as a response to the 2012 Bankstown fire, where the absence of sprinkler protection was found by the coroner to have contributed to one death and one ‘life changing’ injury. By finding accessible and affordable options for designing sprinkler systems, it would be possible to extend sprinkler protection to more Australian homes, including Class 1 buildings.

The results of this research directly informed the 2019 reforms to the NCC requiring the installation of sprinklers in new Class 2 and 3 buildings four storeys or higher and with an effective height less than 25 metres.

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[16] The defined terms in the NCC state that ‘**Automatic** means designed to operate when activated by a heat, smoke or fire sensing device.’

The tests were able to demonstrate the extent to which important tenability requirements relating to occupant safety were met. The test results showed that the tenability criteria were met for sprinklered tests in stark contrast to test results for a benchmark non-sprinklered test.

Test Results

The results of the 13 sprinklered tests revealed a consistency in sprinkler activation times and temperature at the time of activation.

In relation to the effects of sprinklers on heat and atmospheric tenability, sprinklers had a significant effect on both aspects within the structure.

Aside from time to sprinkler activation and spray patterns, a focus on temperature and atmospheric tenability was important. Sprinkler heads operated effectively and as expected in all tests.

In a **non-sprinklered** benchmark burn of the test apartment, the toxicity limit (Fractional Effective Dose (FED) of 0.3 – one of the agreed tenability criteria – was reached at 3 minutes 50 seconds in the bedroom with the bedroom door closed, while temperatures likely to result in flashover (918°C at ceiling height above the ignition point) were achieved in 3 minutes 42 seconds.

By comparison, during the sprinklered tests: the sprinklers successfully operated in all tests; the peak temperatures were all well below flashover; and the highest temperature reached was 372°C at ceiling height above the ignition point. A toxicity level of FED 0.3 was not achieved until the earliest mark of 14 minutes 42 seconds in the closed bedroom.

The other agreed tenability criterion – a temperature above 65°C at 1.6 metres height – was not exceeded significantly in all but one test. In all tests, 65°C was not exceeded at 1 metre.

Source: Fire research report: Residential Sprinkler Research, FRNSW, December 2017

A further reference to tenability/survivability and the benefits of sprinklers is found in the National Fire Sprinkler Association (**NFSA**) *Fire Sprinkler Retrofit Guide*, 2019. This guide, which provides a detailed account of historical fire incidents and fire research, includes the following account of tenability testing and results.

TENABILITY / SURVIVABILITY

It's not just time to flashover that is of concern; it is well known that smoke is the killer, specifically, its components. In January of 2010, the fire research division of the National Institute of Standards and Technology (NIST) conducted experiments regarding room tenability and the impact of the presence of sprinklers. Human untenability criteria was listed as:

- Temperature >120°C
- Oxygen level <13%
- Carbon Dioxide level >8%
- Carbon Monoxide level >1%

The tests were conducted by NIST, in cooperation with the University of Arkansas and the Fayetteville, Arkansas Fire Department, in a 4-story building of fire resistive construction built in the 1950s.

…

The results were unequivocal, only with sprinklers were all tenability criteria kept within the parameters of human survivability, both within the room of origin and its adjoining corridor.

Source: Fire Sprinkler Retrofit Guide, NFSA, 2019

The NFSA document points out that enhanced regulatory safety provisions, like those applying to sprinkler protection, only apply to new buildings. This creates an anomalous outcome with regard to community safety, as existing buildings that are essentially the same as those now being constructed are left with a lower level of safety.

There are practical reasons for this, not least of which are the consideration of cost and complexity associated with retrofit based solutions.

The CSV focus on remediation projects to respond to cladding risk, through the PMCR, provides opportunity to respond to this anomaly by pursuing reasonable opportunity to help extend the benefit of sprinkler protection to more Victorian homes, in situations where it is practical and feasible to do so.

It is also recognised that the risk of a fire inside a building is not mitigated by the removal of cladding on the outside, and that the introduction of sprinklers has the benefit of offsetting cladding related risk and also lowers the risk/increases the safety internally in the building for non-cladding related fires.

6.3 Feasibility of sprinkler retrofitting

The effectiveness of alternative automatic sprinkler systems has been established and the authority to deploy these systems is encoded in Australian building regulation.

The only remaining consideration that must guide a decision to retrofit sprinklers as part of a PMCR solution design, is the feasibility and practicality of doing so. Despite the safety benefits of sprinklers, the cost and complexity of retrofitting sprinklers may render this intervention impractical for some buildings.

To understand the costs and complexities associated with undertaking sprinkler retrofit activity, a project was undertaken in Sheffield, England in 2011. The Callow Mount Sprinkler Retrofit Project was commissioned, funded and overseen by the British Automatic Fire Sprinkler Association (**BAFSA**), and their report of the project published.

"The project resulted in the retrofitting of a fully comprehensive sprinkler system in a 1960s high-rise residential block, 13 storeys high with 47 flats. Sheffield City Council owns the block, which is operated by Sheffield Homes as sheltered housing."
Source: Safer High-rise Living: The Callow Mount Sprinkler Retrofit Project, BAFSA, 2012

The report concluded that the project had minimal disruption for residents, was cost-effective and provides authoritative data to inform planning for similar projects.

It summarises the Sheffield pilot project key findings to reveal that:

- the retrofit was completed with little or no disruption to the residents, who remained in their homes throughout the installation programme;
- the owners of the building and residents expressed a high degree of satisfaction with the workmanship and finished product and in not having to leave their homes or pack up their possessions;
- in recording the full and true costs of this project (and other similar exercises) authoritative data is provided for housing authorities, associations and landlords which will allow them to consider the cost-benefit/effectiveness of installing an automatic sprinkler system;
- the approach adopted provides a template for organisations considering the use of sprinklers when developing their fire safety strategy for such buildings as part of a redevelopment or refurbishment programme, or as a result of actions that may be required following a fire risk assessment;
- the sprinkler installation was carried out at a cost of £1,150 per flat. The cost of annual maintenance will be £250 per year if a contract for the whole block is entered into and if access can be guaranteed at the same time (where this is required), at 2011 prices. The combined cost of installation and maintenance provides an annualised cost per flat of £40 over a 30-year time frame.

Source: Safer High-rise Living: The Callow Mount Sprinkler Retrofit Project, BAFSA, 2012

While this case study suggests that it is feasible to undertake sprinkler retrofit projects of substantial scale, a contemporary Australian perspective relevant to cladding related projects should also be considered.

With some of the buildings for which a PMCR solution will be required, it is possible that sprinklers may only be needed for a small number of SOUs proximate to cladding. Securing building wide approval from owners for a solution where safety benefits accrue disproportionately to a narrow range of owners may prove problematic. In addition, the question of how the costs of retrofitting will be distributed amongst building owners will need to be agreed before a retrofit based solution can be activated.

Anecdotal information available to CSV suggests that there may be a shortage of practitioners accredited to install sprinklers as part of a PMCR solution, particularly those compliant with FPAA 101D and FPAA 101H standards. If the demand for sprinkler retrofitting is high among the CSV in-scope buildings, it may be necessary to encourage practitioner participation in relevant accredited training programs, like those provided by FPA Australia (see http://www.fpaa.com.au/training/introduction-to-fpaa101d-fire-sprinkler-systems-course.aspx).

7 CSV Policy: Sprinkler Protection and Cladding Rectification

This CSV policy statement is released for the express purpose of supporting Minister's Guideline 15. Remediation Work Proposals must have regard to the following policy principles regarding sprinkler protection when addressing the risk associated with combustible external cladding in Class 2 and Class 3 buildings.

Substantial cladding removal is not required on sprinkler protected buildings with an IF-SCAN of 6 or lower

A sprinkler protected building with combustible external cladding and an **IF-SCAN of 6** or below is considered to present a lower risk to life safety than an equivalent building with no cladding and no sprinkler protection[17].

No cladding removal is considered necessary for these buildings in most cases[18].

Instead, remediation works should focus upon measures to optimise the detection of fires and to alert building occupants to assist safe and timely egress.

Cladding located at height requires additional mitigation measures

Substantial areas of cladding (cladding clusters) burning at height cannot be tolerated irrespective of how extensive the active (like sprinklers) and passive safety measures are in a building.

While sprinklers may make the occupants inside a building sufficiently safe to retain cladding, there is a clear understanding that fires at height compromise firefighting efforts and furthermore, substantial facade fires at height are incongruous with community expectation.

Where cladding connects 3 or more SOUs vertically, or 6 or more vertically for ACP-FR, and the area of cladding on the facade is more than 4 storeys above the ground, it is necessary to provide a non-combustible fire break to separate larger areas of combustible cladding.

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[17] Pedersen K, Nguyen K, Hunt A. A Risk-Based Approach to Assess the Effectiveness of Sprinklers in Buildings with Combustible Cladding. Fire. 2025; 8(4):119. https://doi.org/10.3390/fire8040119

[18] Exceptions to this general provision are identified in the Cladding Rectification Standards.

7.1 Fire breaks to separate clusters at height

The policy here considers the increase in risk associated with buildings at height.

For ACP-PE and EPS buildings:

Any cladding cluster containing ACP-PE and EPS presents a risk that is tolerable without further fire safety engineering considerations of the cladding, provided that the cladding cluster values are not more than[19]:

- **6 SOUs total** in a building where SOUs are sprinkler protected

Further to the above:

a) At the 5th storey or above:
- For every **3 vertical levels of cladding** retained, a non-combustible fire break of 3 vertical levels is required (i.e. 3 levels on, 3 level off)[20], and
- Smoke alarms to be installed to bedrooms in line with E.01.

b) Where the cladding is installed as thin vertical strips less than 1000mm total width of material:
- A fire break of one floor level only is required (per 6V)

For ACP-FR:

Any cladding cluster containing ACP with a higher proportion of flame-retardant filler relative to polyethylene (ACP-FR) presents a risk that is tolerable without further fire safety engineering considerations of the cladding, provided that the cladding cluster values are not more than[21]:

- **Up to 10 SOUs total**.

In cases where there is ACP-FR:

a) At the 4th storey and below
- **Any** cladding cluster value

b) At the 5th storey or above:
- For every **6 vertical levels of cladding** retained, a non-combustible fire break of 1 vertical level is required (i.e. 6 levels on, 1 level off) [22],
  - i. Maximum cluster size in total of 10 SOUs *AND*
  - ii. Maximum of 10 levels connected vertically in total, being 4 SOUs below the 5th storey plus 6 SOUs at the 5th storey and above; and
- Smoke alarms to be installed to bedrooms in line with E.01

c) Where the cladding is installed as thin vertical strips less than 1000mm total width:
- No fire break is required

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[19] PMCR Document E.01 can be found at *https://www.vic.gov.au/sites/default/files/2024-03/E.01-Cladding-Risk-Policy-Trivial-and-Tolerable-Cladding-Risk-V2.pdf*

[20] These values are based on witnessed test evidence of three levels for fully clad (with ACP PE) wall and a three-level fire break.

[21] PMCR Document E.01 can be found at *https://www.vic.gov.au/sites/default/files/2024-03/E.01-Cladding-Risk-Policy-Trivial-and-Tolerable-Cladding-Risk-V2.pdf*

[22] This is based on witnessing of fire testing organised by CSV.

Cavity barrier requirements for fire breaks

- When separating a larger cluster of cladding into manageable clusters, cavity barriers are required to break the continuity of the external wall cavity;
- The barrier should be applied to the bottom and the top of the firebreak, and consideration should be given as a priority to metal cavity barriers before intumescent barriers, loaded mineral wool or other cavity barriers.

7.2 Retrofitting sprinklers in non-sprinklered buildings should be considered

The heightened level of safety created by the availability of sprinklers, necessitates consideration being given to retrofitting sprinklers into non-sprinklered buildings.

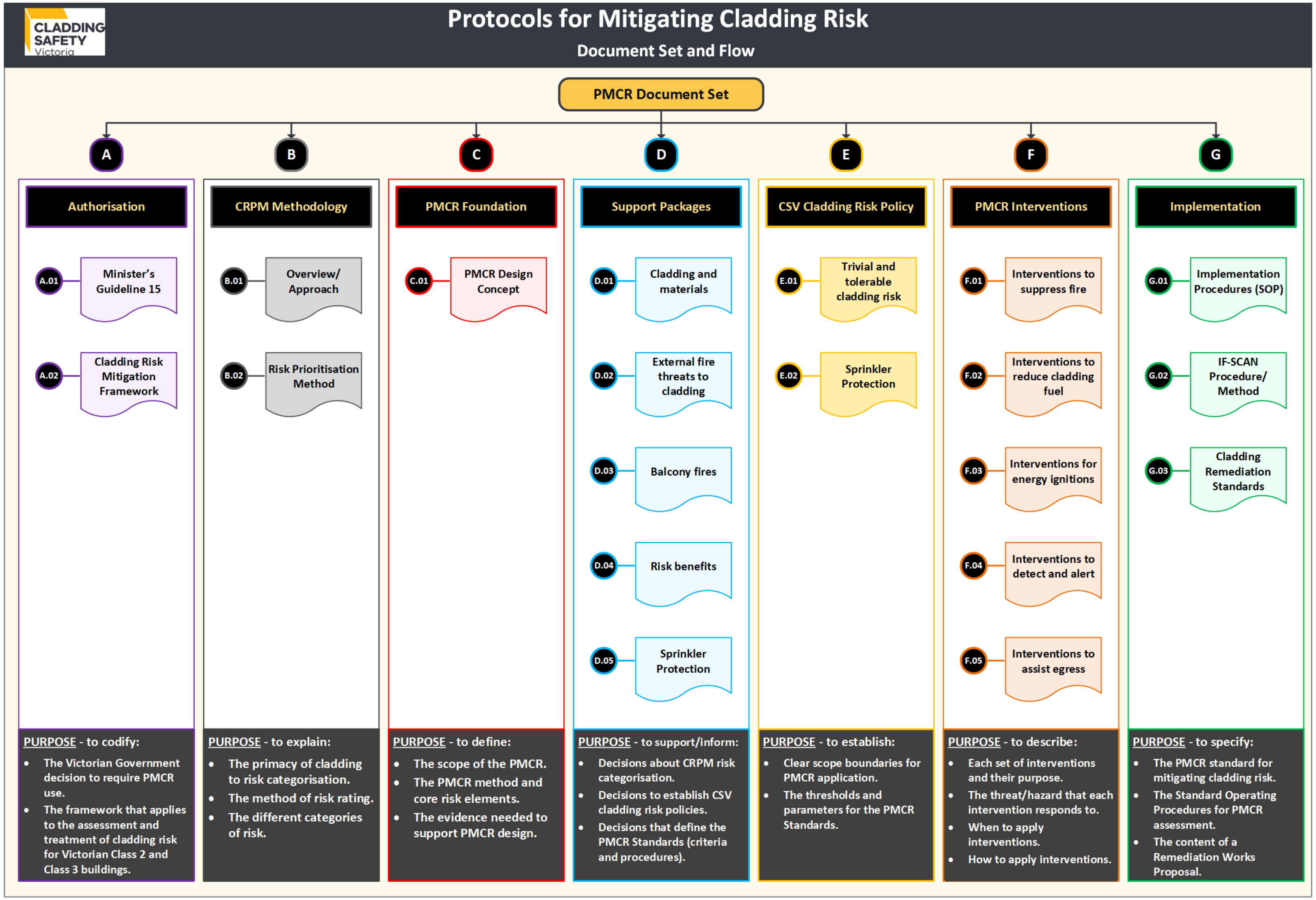
Where feasible (practical and not cost prohibitive), sprinkler extension work should leverage any existing NCC compliant sprinkler system within the building.

Where the building has no existing sprinkler infrastructure or it is impractical to use it (where available), remediation works should consider other NCC compliant sprinkler systems:

- FPAA 101H Automatic Fire Sprinkler System Design and Installation – Hydrant Water Supply – where the provision of SOU sprinklers can tap into existing hydrant booster systems (as would be available for any building with an underground carpark or having 40 or more SOUs, commensurate with NCC requirements).
- FPAA 101D Automatic Fire Sprinkler System Design and Installation – Drinking Water Supply – where there is no access to an existing hydrant booster system (as would be the case for a building without an underground carpark and with less than 40 SOUs) or where the cost of installing a FPAA 101H system is excessive.

Appendices

Appendix A: PMCR document set and flow



Appendix B: PMCR threat barrier approach

The Protocols for Mitigating Cladding Risk have been designed to provide a systematic and repeatable method for mitigating fire risk created by combustible cladding on Victorian residential multi-storey dwellings. The PMCR is a published set of evidence-based rules that can be applied to remedy cladding risk on a set of Victorian buildings and allow cladding related enforcement obligations currently imposed on Victorian building owners to be removed.

A threat barrier analysis can be used to represent how risk-mitigating actions can function to respond to a problem. The PMCR employs this analysis technique to identify the central problem (the 'top event'), in this case a cladding fire, and depict how risk associated with the problem can be mitigated through the implementations of barriers (interventions) designed to control the key hazards identified.

There are **15 interventions** identified from the threat barrier analysis and the full list of interventions can be found in the *Cladding Risk Mitigation Framework*.

The **15 interventions** act in different ways to mitigate cladding fire risk. Each intervention may:

- Respond to one or more of the four identified hazards;
- Function to prevent an ignition source from spreading fire to cladding (i.e. interventions that reduce the likelihood of a fire igniting cladding); and/or
- Function to reduce the adverse impacts for building occupants once a fire has reached cladding (i.e. interventions that reduce the consequences of a cladding fire).

Any risk mitigation solution designed using the PMCR must target credible hazards on a building and balance both cladding ignition likelihood and consequence considerations.

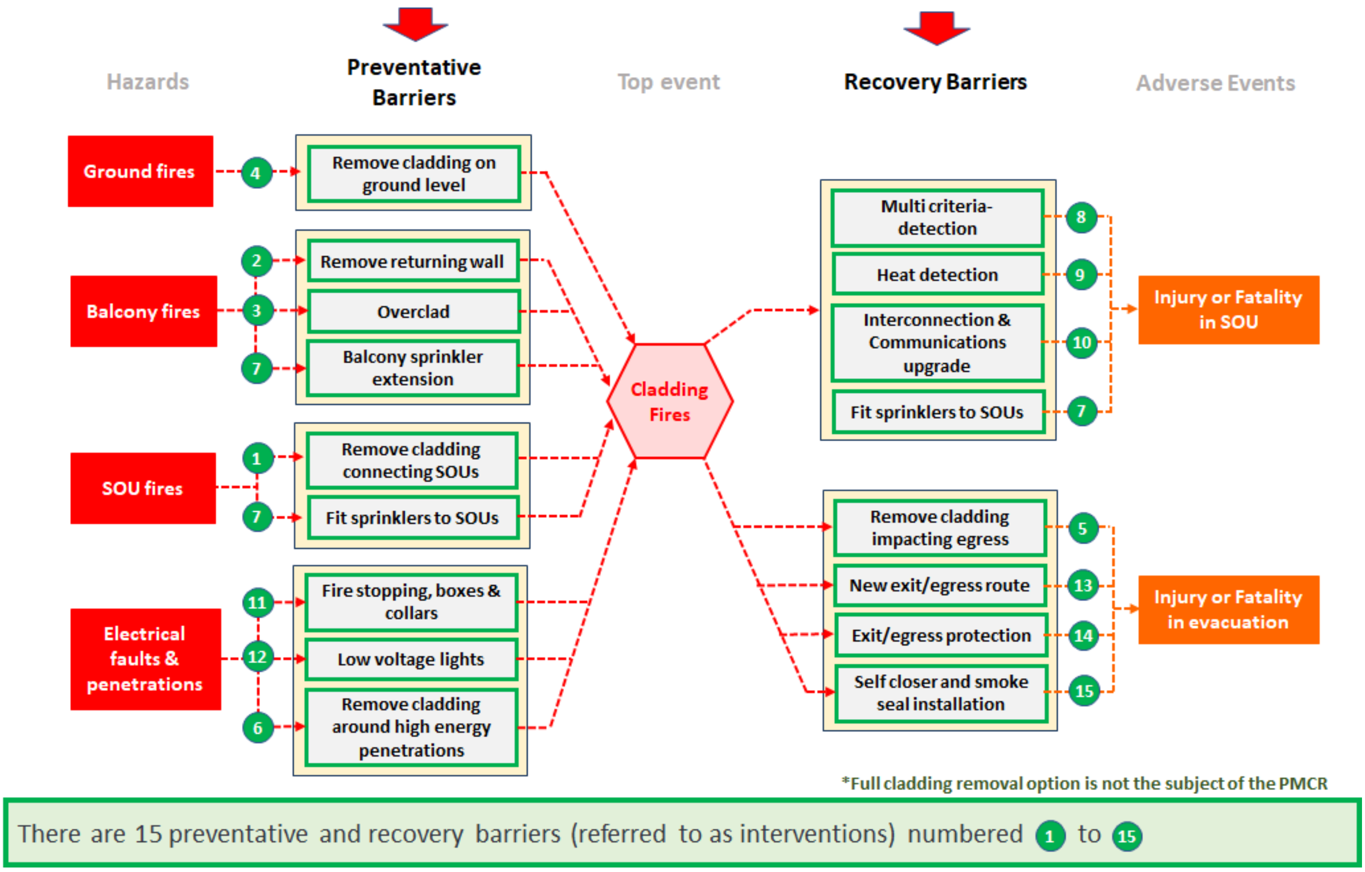


Figure 8: PMCR threat barrier analysis