Protocols for Mitigating Cladding Risk

Cladding Risk Prioritisation Model Methodology

B.01 – Overview/Approach

Version 2

Date: 13 March 2024

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.

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Abbreviations

Acronym	Description / definition
ACP-PE	Aluminium composite panel with a polyethylene core
ARP	Advisory Reference Panel
CRPM	Cladding Risk Prioritisation Model
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CSV	Cladding Safety Victoria
DELWP	Department of Environment, Land, Water and Planning
DTP	Department of Transport and Planning
EPS	Expanded Polystyrene
FRA	Fire Risk Assessment Tool (developed for the NFPA)
FRV	Fire Rescue Victoria, formerly the MFB
iAuditor Reports	A form of site inspection report, providing information relevant to a range of risk factors
IF-SCAN	Initial Fire Spread in Cladding Assessment Number
LRM	Logical Ranking Method
MFB	Melbourne Metropolitan Fire Brigade
NFPA	National Fire Protection Association
RAT	Risk Assessment Tool
SCA	State-wide Cladding Audit
SOU	Sole Occupancy Unit
VCT (Taskforce)	Victorian Cladding Taskforce
VBA	Victorian Building Authority

The imperative for risk-based prioritisation

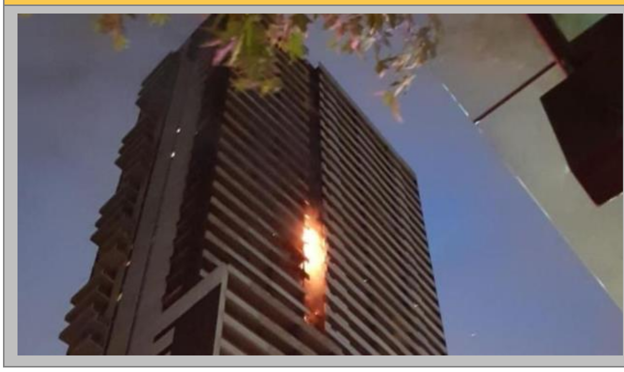
Cladding Safety Victoria (**CSV**) was announced on 16 July 2019 to oversee the investment of $600 million provided by the Victorian Government for the purpose of **reducing the risk** associated with the use of combustible cladding on Class 2 residential apartments in Victoria.

This was a direct response to a number of prominent and significant fire events in which the threat to building occupants, users and fire fighters was magnified by the presence of combustible cladding.

Lacrosse, Melbourne, 24 November 2014

Grenfell Tower, London, 14 June 2017

Neo 200, Melbourne, 4 February 2019



The Victorian Cladding Taskforce (**Taskforce**) recognised that the level of risk posed by combustible cladding varies for each building.

The Taskforce recommended that:

> *" . . . the Victorian Government take a risk-based approach to prioritising buildings for funding in the program of rectification of private buildings."* (Recommendation 21)

The State-wide Cladding Audit (**SCA**) has referred more than 720 buildings to CSV.[1]

These buildings were referred for CSV review because they have been assessed by an expert panel as having a rating of *extreme* or *high* using the Risk Assessment Tool (**RAT**) developed by the Department of Transport (**DTP**) and Planning[2].

The RAT provided limited value in:

- differentiating between buildings on risk-based grounds; and, in particular
- identifying those buildings for which cladding adds greatest to fire risk.

In August 2020, CSV initiated a project to develop a method for the risk-based prioritisation of buildings that CSV could use to target limited investment funds for the removal of cladding.

A Cladding Risk Prioritisation Model (**CRPM**) was developed using the combined capabilities of the Commonwealth Scientific and Industrial Research Organisation (**CSIRO**) Data61 and a CSV panel of building and fire safety experts.

This document provides an overview of the CRPM design and its application by CSV.

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[1] In the period to 30 June2021, 722 buildings had been referred to CSV.

[2] Formerly the Department of Environment, Land, Water and Planning (DELWP).

1 Model purpose

The purpose of the model was to generate a prioritised list of buildings for CSV application that could be used to best **reduce harm to people** arising from the use of **combustible cladding**.

The generation of a **risk prioritised list** of buildings was intended to:

- make use of the best building risk data available; and
- incorporate new data insights that strengthen the capacity for prioritisation.

A risk prioritised list was used to serve as a primary input to funding prioritisation decisions made by the leadership team of CSV[3].

2 Design principles

The CRPM was designed and developed in accordance with the following design principles:

1. **First consideration is cladding-specific risk**
   The model must give **PRIMACY** to the risk posed by combustible cladding above other fire risk factors. The imperative for CSV to invest in enhanced fire safety is due solely to concerns about cladding and so cladding's contribution to risk must be the primary determinant of prioritisation.
2. **Other non-cladding risk factors are secondary considerations**
   Other fire risk factors will influence risk prioritisation as **SECONDARY** considerations. These non-cladding fire risk factors point to important safety concerns that continue to be the focus of compliance programs pursued routinely through regulatory mechanisms.
3. **Increased discriminatory power**
   The model must increase discriminatory power (i.e. the ability to distinguish between buildings on risk-based grounds), beyond the level currently available. The RAT provides only for the coarse differentiation of some 700 buildings into two risk groups.
4. **Prioritise based on structural issues**
   Some risks are attributable to the fixed structure of buildings (like the use of cladding as a part of a wall system and the construction of exits and passages), while others are systems based and more readily subject to change over time (warning systems, maintenance regimes, etc). The CSV capital works program must be driven by structural risk factors and not diverted by other risk factors. Transient risks (like the maintenance of Essential Safety Measures (ESMs)) must continue to be managed independently of CSV through routine compliance programs.
5. **Leverage available data**
   Best (and appropriate) use must be made of available building fire risk data. The imperative is to build the model using accessible and available data rather than delay the model unduly in the pursuit of an "ideal" dataset.
6. **A prioritised list is the start of the prioritisation process and not the end**
   Prioritisation decisions will be made by people and not by a model. To that end, a risk prioritised list will be **one** input to a prioritisation decision and not **the** output of a prioritisation decision. Consistent with this principle, other information (not incorporated in the model) may need to be considered to inform a decision about a building's priority.

These principles were developed through the initial phase of CRPM planning and design.

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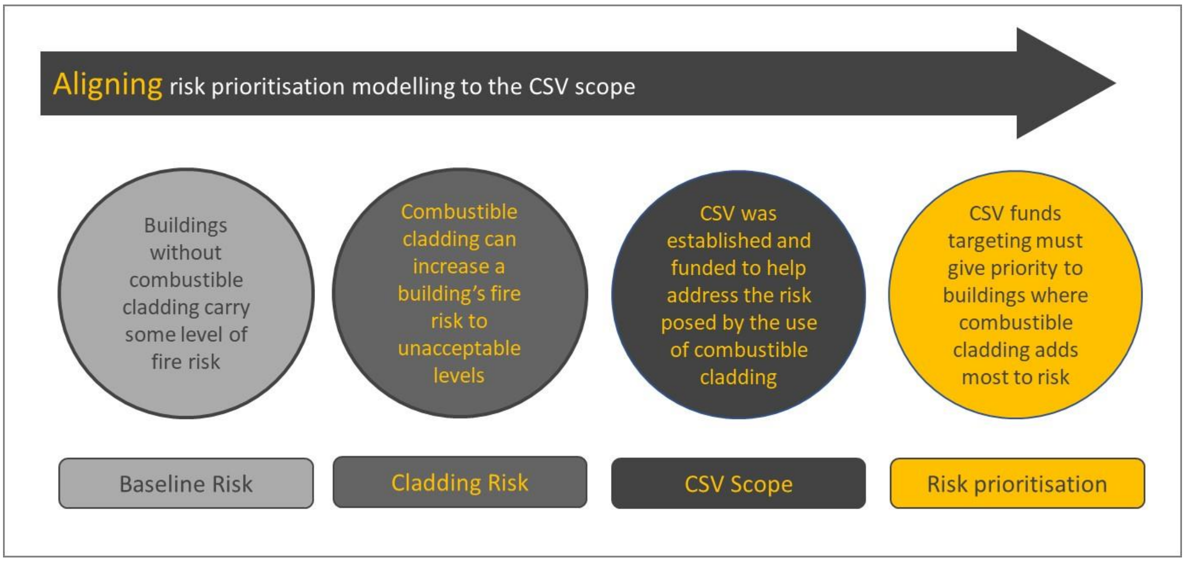
[3] This recognises that data models are limited by the data available and the quality and coverage of the data, and so factors outside the model will and should guide any CSV decision to approve or deny funding for cladding rectification works.

3 Risk mitigation – a CSV perspective

CSV has been tasked with using funding provided by the Victorian Government to undertake cladding removal works over five years.



CSV work is undertaken with a clear understanding that this substantial public investment in enhanced building fire safety is intended to avert large and difficult to control cladding-fuelled fires, like those that took place at the Lacrosse and Neo200 buildings in Melbourne and the Grenfell Tower in London.

This does not mean that there is no interest in the avoidance of small cladding fires, but recognises that the avoidance of large and potentially catastrophic cladding fire events must be the principal risk driver for CSV works prioritisation.

Accordingly, CSV's risk mitigation focus was drawn firstly to those buildings where the type, quantity and configuration of cladding, in combination, presented the greatest threat of rapid and extensive fire spread across a building's facade. As a point of precautionary reasoning, it was expected that:

- a **large fire spread** across a building facade (via cladding) will impact a larger number of building occupants/users (**unacceptable risk**); and in relative terms
- a **small fire spread** across a building facade (via cladding) will impact a smaller number of building occupants/users (**acceptable risk**).

To prioritise funding decisions on the basis of risk requires the boundary between acceptable and unacceptable risk to be defined.

The concept of risk tolerance is an issue for consideration by all major stakeholders with an interest and/or role in building fire safety and remained a subject largely beyond the scope of this modelling project. Nevertheless, risk threshold issues had to be considered and defined within the project scope in order to establish a key input parameter for the CRPM.

In developing the CRPM, it was necessary to contemplate three core dimensions of risk:

1. the **consequence** of a cladding fuelled fire;
2. the **likelihood** of a cladding fuelled fire; and
3. the **tolerance** threshold for accepting risk (from a funding decision perspective).

The remainder of this section provides information about how each of these dimensions has informed the development of the CRPM.

3.1 Risk framework

The approach to the development of the CRPM aligns to the international standard for risk management (AS ISO 31000:2018), recognising that *risk = likelihood x consequence*.

The CRPM Project Team considered that an optimal conceptual framework for integrating the core risk elements for modelling cladding fire risk would comprise those shown below.

Likelihood	x	Consequence	=	Risk
Consider the contribution that combustible cladding on a building makes to the likelihood that: 1. A fire will ignite cladding 2. A fire will intensify via cladding 3. A fire will be spread by cladding	→	Focus upon the potential harm to people and consider the potential impact (of a cladding fuelled fire) on: 1. People living in or using a building 2. People fighting a fire in the building	→	The highest priority buildings will be the ones where the likelihood factors combine to: ▪ Increase the risk exposure for people - consequence BY ▪ Making escape untenable; and ▪ Significantly curtailing the chance for fire suppression

The method that was developed drew substantially on the data provided through the risk assessment work already conducted by earlier experts under the SCA using the RAT.

The CRPM combines:

- existing risk understanding captured through RAT assessments; with a new measure of
- how the presence of combustible cladding on a building adds to fire risk (above and beyond the fire risk associated with other features of each building) – a **cladding risk premium** of sorts.

The availability of the new measure allowed decisions to be made about prioritisation guided by an understanding about how cladding contributes to building fire risk in its own right (i.e. independently of other risk factors).

Limits in the availability of data reduced the capacity to fully apply all elements of the optimal framework to the risk assessment of buildings, particularly in relation to likelihood.

In the absence of perfect data, the CRPM risk framework adopted a qualitatively driven approach to the representation of:

- **Consequence**

  In relation to consequence, the CRPM sought to answer the question:

  How extensive will the initial fire spread be across a building facade via combustible cladding under a worst case scenario?

  This constitutes a **maximum foreseeable loss** measure, referred to as the **I**nitial **F**ire **S**pread in **C**ladding **A**ssessment **N**umber (**IF-SCAN**). See section 5.1 for a more detailed explanation.

- **Likelihood**

  In relation to likelihood, the CRPM sought to answer the question:

  Is it plausible that a fire can ignite in cladding at a place that would give rise to a worst case consequence (as represented by the IF-SCAN)?

  This constitutes a **plausibility** test, indicating that a consequence estimate (the IF-SCAN) is only appropriate for a cladding location where the initiation of a fire is plausible.

Further information about the treatment of risk within the CRPM is provided in Appendices 1 and 2.

The role of expert judgement[4]

The substantial differences between buildings (in both design and risk profile) and the limits of data coverage/reliability make it inevitable that expert judgement must play an important role in risk-based prioritisation decision-making.

The importance of expert judgement to the prioritisation of Victorian rectification works was recognised well before CSV's formation.

The work of the Taskforce initiated the SCA and positioned experts at the centre of the assessment process.

"The key role of the expert panel is to jointly review a comprehensive inspection report and apply that information to our risk assessment tool."[5]

The design and introduction of the RAT by DTP (formerly DELWP) provided the tool for expert use that is referenced by the Taskforce. DTP's guidance document for the RAT identifies the limitations of the RAT and the requirement for an additional level of expert judgement.

"The Risk Assessment Tool is not intended as a substitute for expert judgement. Results should be interpreted by a panel of suitably qualified building practitioners, including a fire safety engineer, a building surveyor, and a representative from the relevant fire service (MFB or CFA)."[6]

The extract below from the CSIRO Data61 paper, *A risk prioritization method for residential buildings with combustible cladding: A Report for Cladding Safety Victoria*, provides a brief literature review covering the use of expert judgement for purposes like those pursued by CSV.

Human expertise and risk assessment

Quantitative risk assessment and modelling requires data on the frequency of initiator events as well as conditional event probabilities. Because empirical data is often not readily available or difficult to obtain through other means, expert judgement has been found to be a valuable method and source of information [Rosqvist and Tuominen, 1999]. Expert judgement is useful when other measurements, observations or data sources are unavailable or can be used to supplement existing sparse or questionable data [Meyer and Booker, 1990]. Criticism of expert judgement methods focus on issues such as potential expert bias, or that judgements can demonstrate high variability across the experts which would prohibit accurate estimations. Therefore, a clear method has to be established to achieve consensus amongst experts [Cooke and Goossens, 2008].

Research shows that people are better in making relative judgements, such as pairwise comparisons, rather than direct estimates [Meyer and Booker, 1990]. Meyer and Booker argue that most people are reliable estimators using pairwise comparisons. Such comparisons are well within the limits of information processing capabilities as only two alternatives have to be considered at a time. Furthermore, after brief introduction to the method, people usually find such comparisons an easy method to use. Yet, the method can be time consuming if all possible combinations of pairwise comparisons have to be elicited and it only provides relative data relations. Other evidence for the value of relative judgements also comes from research on eyewitness identification of crime suspects. For example, results from Moreland and Clark [2020] suggest that "side-by-side comparisons increase diagnostic accuracy by allowing witnesses to give greater weight to more diagnostic features and less weight to less diagnostic features". Goffin and Olson [2011] provide social cognitive as well as evolutionary explanations for why people make more accurate ratings using comparative measures ratings as compared to absolute ratings.

In our CRPM method for buildings with combustible cladding we strongly emphasize the assessment of relative risk, and are in keeping with the findings in the literature above.

The function of the CRPM, in this context, was to give structure and focus to enable the systematic application of expert judgement to prioritisation decisions.

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[4] Expert judgement is used as a general term and not to be confused with the term defined in the BCA.

[5] Victorian Cladding Taskforce, Report from the Co-Chairs, July 2019.

[6] Cladding Risk Assessment Tool Guidance, Department of Environment, Land, Water and Planning, May 2018.

Actions in other jurisdictions

The approach adopted for the design of the CRPM was consistent with work in other jurisdictions.

For example, the National Fire Protection Association (**NFPA**)[7] has developed a tool to inform a decision to prioritise risk mitigation planning for buildings with combustible wall systems. Similar to the CRPM, the Fire Risk Assessment (**FRA**) tool developed by NFPA:

- adopts a qualitative assessment method;
- recognises and contends with limits in the availability of data;
- relies substantially on expert judgement;
- considers threat to life above other consequences;
- is narrowly focussed, only applicable for buildings with combustible wall systems; and
- focusses solely on prioritisation and not on remediation solutions.

Extracts from a key NFPA document are presented in the callout box below to articulate some of the foundation tenets that underpin the development of the FRA.

> "... Because there is **limited test data or statistics** to further inform a quantitative approach to risk ranking or scoring, a **qualitative assessment** is being utilized based on engineering judgement.
>
> The goal of this project has been to develop and make available a risk assessment methodology to assist global authorities to assess the risks and prioritize inspection/remediation efforts for the high rise building inventory in their jurisdiction with exterior wall assemblies containing combustible components. The methodology is qualitative rather than quantitative and follows internationally recognized risk assessment approaches. The **method does not recommend specific mitigation measures, but rather prioritizes the need for mitigation based on risk factors** and provides suggestions for possible mitigation to be assessed on a project by project basis."
>
> "At the request of NFPA, the FRA tool focuses on **life safety only**."
>
> "The FRA tool is applicable in any geography but is currently limited to residential (hotel, apartments) or business (office) or a mix of both occupancies that are over 18m high where height is measured as the total vertical distance from fire department access level to the finished floor level of the top most occupied floor of the building. NFPA selected these occupancies for the FRA tool as the majority of high rise buildings internationally are these types of occupancy.
>
> The **FRA tool is intended to** be used by Enforcers or Authorities Having Jurisdiction (AHJ) to assess a portfolio of buildings across a town or city where there is a concern that the exterior facade systems are built-up from combustible materials. The FRA tool is intended to **provide a framework** to aid the AHJ to **prioritize buildings** in their jurisdiction **and to conduct fire risk assessments of each building**, assessing the highest priority buildings first."
>
> "It is important to note that the **FRA tool is for existing buildings with combustible façade systems only**. It assumes there is the potential for fire spread to multiple stories of the building via the façade system. The guidance is not appropriate for the risk assessment of buildings without a combustible façade ..."

Source: *High Rise Buildings with Combustible Exterior Wall Assemblies: Fire Risk Assessment Tool*, National Fire Protection Association, USA, February 2018 (https://www.nfpa.org//-/media/Files/News-and-Research/Fire-statistics-and-reports/Building-and-life-safety/RFEFFECTReport.pdf)

The NFPA information presented here is not exhaustive and is presented here only to illustrate some of the parallels in the foundation considerations that informed the design and development of the CRPM.

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[7] The NFPA describes itself as "a global self-funded nonprofit organization, established in 1896, devoted to eliminating death, injury, property and economic loss due to fire, electrical and related hazards". The NFPA central office is located in Massachusetts, USA.

3.2 Consequence

A significant cladding fuelled fire can cause loss (consequences) across multiple dimensions:

- loss of life and injuries;
- loss of property;
- loss of livelihood;
- economic loss; and
- loss of amenity.

While recognising all dimensions of loss that can be attributed to a major building fire, the CRPM focus on consequence was driven only by consideration of the threat to life. This means that the measure of consequence must be driven by how cladding fire risk impacts a building's occupants.

7 in 10 buildings referred to CSV are 3 or 4 storeys and accommodate 25% of the people threatened by cladding

1 in 8 of the buildings referred to CSV are high-rise, yet these accommodate over 50% of the people that CSV's cladding rectification activities is trying to protect

Inevitably, the most significant impacts of a cladding fuelled building fire are borne by the people who live in a building. One piece of data available to the CRPM for all buildings is the number of apartments that are in each building.

The baseline building data available to CSV included a count of the sole occupancy units (**SOU**) within a building. An SOU is a single dwelling unit or apartment and this variable served as the primary unit of analysis for estimating potential fire loss consequence.

The SOU count is an imperfect measure of consequence exposure insofar as the data provides a count of physical spaces and does not take account of:

- occupancy rates; and
- differences in dwelling density (i.e. persons per SOU) by building type and location.

However, the assessment of facade fire spread applied through the CRPM can be considered in relation to a building's design and the potential impact of a fire on SOUs can be quantified.

The consequence measure employed for the CRPM is a count of the number of SOUs that would be impacted by a cladding fuelled facade fire in the initial fire spread, if cladding were to be ignited in the worst possible location on a building facade.

For further information, please see section 5.1.

3.3 Likelihood

The public investment in cladding removal through CSV has been directed in a way that is intended to prevent large scale cladding fuelled fires that would pose a significant threat to life.

These rare extreme events have a low probability of occurrence, with the frequency of any occurrence in a jurisdiction being represented as a ‘1 in *n* years’ category of event. In other words, the likelihood of a significant cladding fuelled fire occurring on any individual Victorian apartment building is very low in any given year. Over a longer time period, however, there is a greater likelihood that such an event will occur somewhere.

Identifying which building is most likely to be the next ‘1 in *n* years’ major cladding fire incident for Victoria is influenced by the ability for a fire to originate from a variety of sources, as listed below.

Internal ignition sources	External ignition sources
▪ Within SOU (kitchens, bedrooms) ▪ Periphery of SOU (balconies, canopies) ▪ Common areas	▪ Adjacent building fire ▪ Vegetation fire spread ▪ Traffic, powerlines, gas ▪ Negligent and malicious act ▪ Litter and stored materials ▪ Commercial activity

Introducing a meaningful measure of likelihood to inform the prioritisation of CSV rectification works planning is complicated by:

- A lack of consistently captured and reliable data that would enable ignition threat likelihood to be meaningfully quantified (as a stable risk differentiator);
- An observation that the greatest ignition threats are probably transient, representing ignition risks that can be reduced through behavioural changes (barbeque use on balconies, safe storage practices, street side litter management, etc) – see below; and
- The constraints in relating all of the individual ignition sources on any building to where combustible cladding is located.

Laneway litter as an ignition source

Balcony clutter increases ignition risk

A calculated measure of ignition likelihood was considered unlikely to provide a reliable representation of relative ignition threat using the data available. As such, the CRPM method adopted a qualitative assessment of cladding ignition plausibility as a substitute for a strict measure of ignition likelihood (refer to Appendices

Appendix A: Assessing plausibility in a risk context) for further information about plausibility based risk considerations).

The key plausibility test informing CRPM prioritisation dictated that:

- Quantifying the worst case cladding facade fire spread could only be undertaken for a location (on the facade) where it was considered plausible that a fire could ignite cladding.

A facade location can be considered a plausible location for cladding to ignite where the cladding is proximate to:

- A balcony;
- A building opening;
- Established vegetation;
- Ground level/basement carpark;
- Laneways and street-side traffic; or
- Adjacent buildings.

Having established that cladding ignition at a particular point on a building facade is plausible, a count of impacted SOUs was then able be estimated (see section 5.1).

3.4 Risk tolerance

The scale of the problem associated with the use of combustible cladding on multi-storey apartments is vast. While the number of buildings with combustible cladding is large, the fire risk posed by cladding on each building varies.

It can be reasonably assumed that the presence of combustible cladding:

▪ will elevate fire spread risk **significantly** on some building	which should elicit an immediate and comprehensive risk mitigation response
▪ will elevate fire spread risk **moderately** on some building	which should elicit a proportionate and affordable risk mitigation response that is not urgent
▪ will elevate fire spread risk **marginally/negligibly** on some building	which should result in no action being required

This observation is supported by the IF-SCAN assessments undertaken using the CRPM. These assessments showed that the number of SOUs impacted by a worst case fire spread across building facades via cladding ranges from 0 to 75 SOUs for 400 buildings that had been assessed using this method in the period to August 2021 (when the first edition of this report was completed).

From a **CSV funding prioritisation perspective**, CSV has used the IF-SCAN assessments as a means of setting risk tolerance thresholds that define scope boundaries for funding purposes. This step was essential for a program where there are limits on funding available for cladding removal. See section 5.1 for details about threshold levels.

From a **regulatory perspective**, it is important to define and communicate risk tolerance thresholds beyond the scope of funded programs.

In the absence of clarity around notions of acceptable risk, owners face issues associated with:

- remediation costs;
- essential works specification;
- building insurance and escalation of annual premiums; and
- resale encumbrances.

CSV has used the CRPM to enable a narrow application of risk tolerance concepts for the purposes of funding prioritisation. However, CSV's interpretation of risk tolerance remains part of a broader regulatory paradigm that is beyond the scope of the CRPM or this paper.

4 The Logical Ranking Method

A process was designed by CSIRO Data61 to assist CSV in:

- Integrating and organising a body of building risk data;
- Selecting the primary risk factors that should inform prioritisation decisions;
- Assigning buildings to cohorts in which all member buildings share equivalent cladding fire risk characteristics; and
- Enabling expert decisions about the relative ranking of building cohorts.

A description of the process prepared by CSIRO Data61 is presented in the callout box below.

The primary risk approach applied to the risk modelling involves the use of a method that is being termed the Logical Ranking Method (**LRM**). The LRM method derives from mathematical optimisation, statistical classification tree and project management techniques.

- When applied to building fire risk assessment, it involves classifying each building according to a defined number of risk factors. Each risk factor has a numerical or categorical scale. A building with a higher value for a risk factor has a higher risk compared to another building with a lower value for the same risk factor, all other factors being equal (whether the risk is higher or lower depends on the sense of the scale).
- The building classification information then allows precedence relationships, or dominance rules, to be formed between buildings based on risk factor values. If one building has risk factor values that are equal or more risky for every risk factor, compared to another building, then the former building must precede the latter in the priority list. Buildings with exactly the same risk factor values are in the same cohort, are ranked together, and their relative order can be decided later.
- The full priority list is extended one building cohort at a time. When the list is being built, only those building cohorts that are currently non-dominated (i.e., have no predecessors which are yet to be put in the list) should be considered to come next. Decision-makers decide the next cohort amongst the non-dominated cohorts based on their judgement of the relativity between factors and on their judgement of the details of the buildings in each cohort.

In this way, the logic of precedence/dominance makes it impossible to incorrectly rank a provably less risky building higher in the priority list. Errors/anomalies can only come from mis-measurement of building risks, from poor choice of risk factors, or from suboptimal choices of next-cohort amongst the non-dominated cohorts at any step. This gives the prioritisation process only a limited exposure to anomalies, and otherwise we are logically assured of a list that has defensible rankings, hence the method name.

In this process, the interest is less about scoring and more about comparisons and relative ranks.

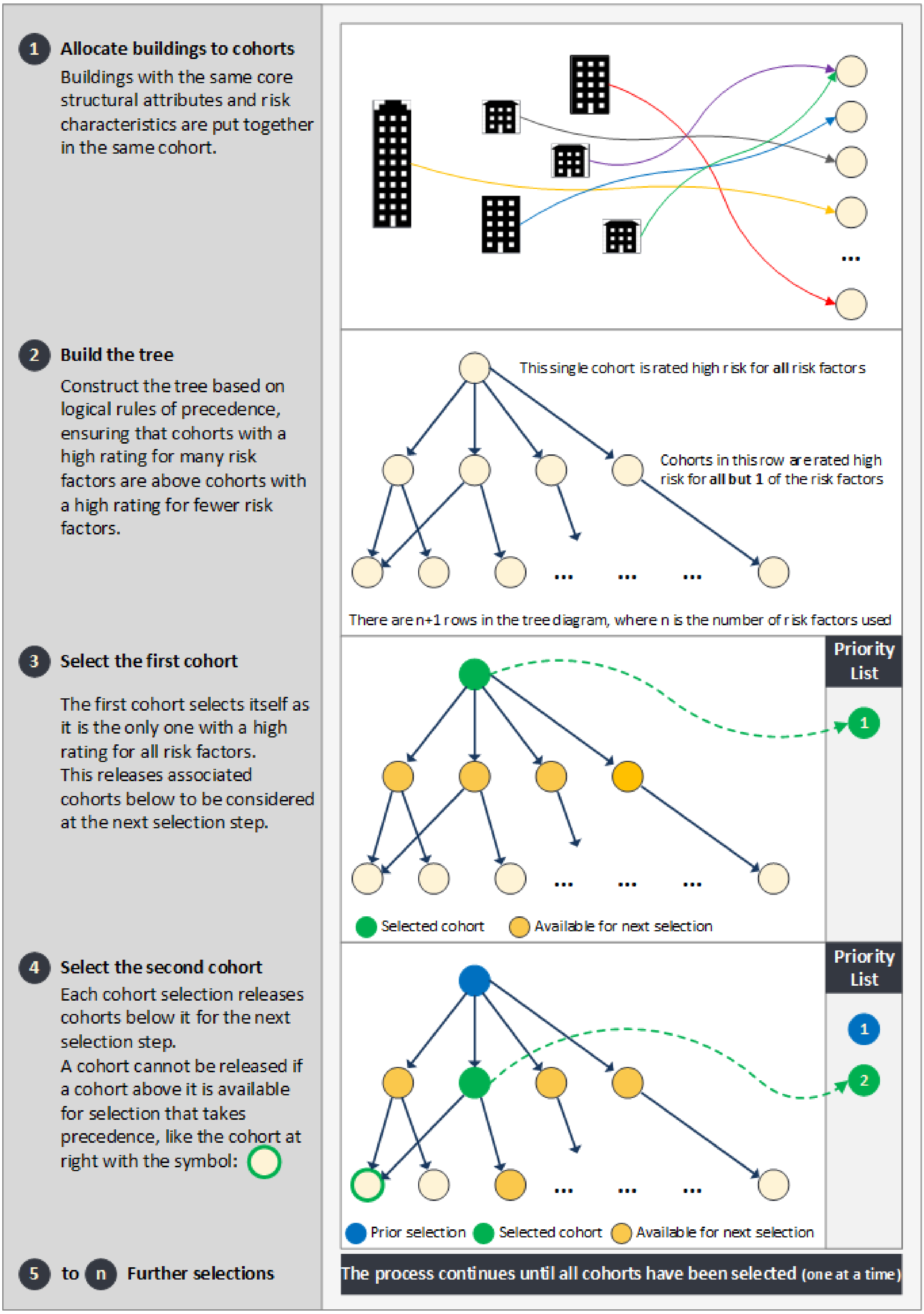
Technical information about the method can be found in the CSIRO Data61 paper, *A risk prioritization method for residential buildings with combustible cladding: A Report for Cladding Safety Victoria*.

Further summary information about the technical method is provided in Appendix B.

To assist CSV experts in navigating the building cohort information, CSIRO Data61:

- presented cohort information in a tree diagram format;
- developed a process of ‘walking the tree’ – essentially working down the tree from the top (highest risk cohort) to bottom (lower risk cohorts);
- identified the next logical set of cohorts in the precedence order to be reviewed at each prioritisation step (i.e. the cohort list was built one cohort at a time); and
- extracted cohorts one at a time until all cohorts had a place in the rank order.

This is illustrated at a high level overleaf.



Before this cohort ranking process could be performed, it was necessary to compile risk data, complete IF-SCAN assessments and allocate buildings to cohorts (see section 5.4).

5 Prioritisation steps – sorting and sequencing

The approach adopted for prioritisation involved a system of structured **sorting** and **sequencing**.

The approach required:

1. **All buildings to be assigned to groups -** the **sorting** phase

   Within each group (referred to as cohorts), all buildings have the same fire safety protection and risk characteristics; and then

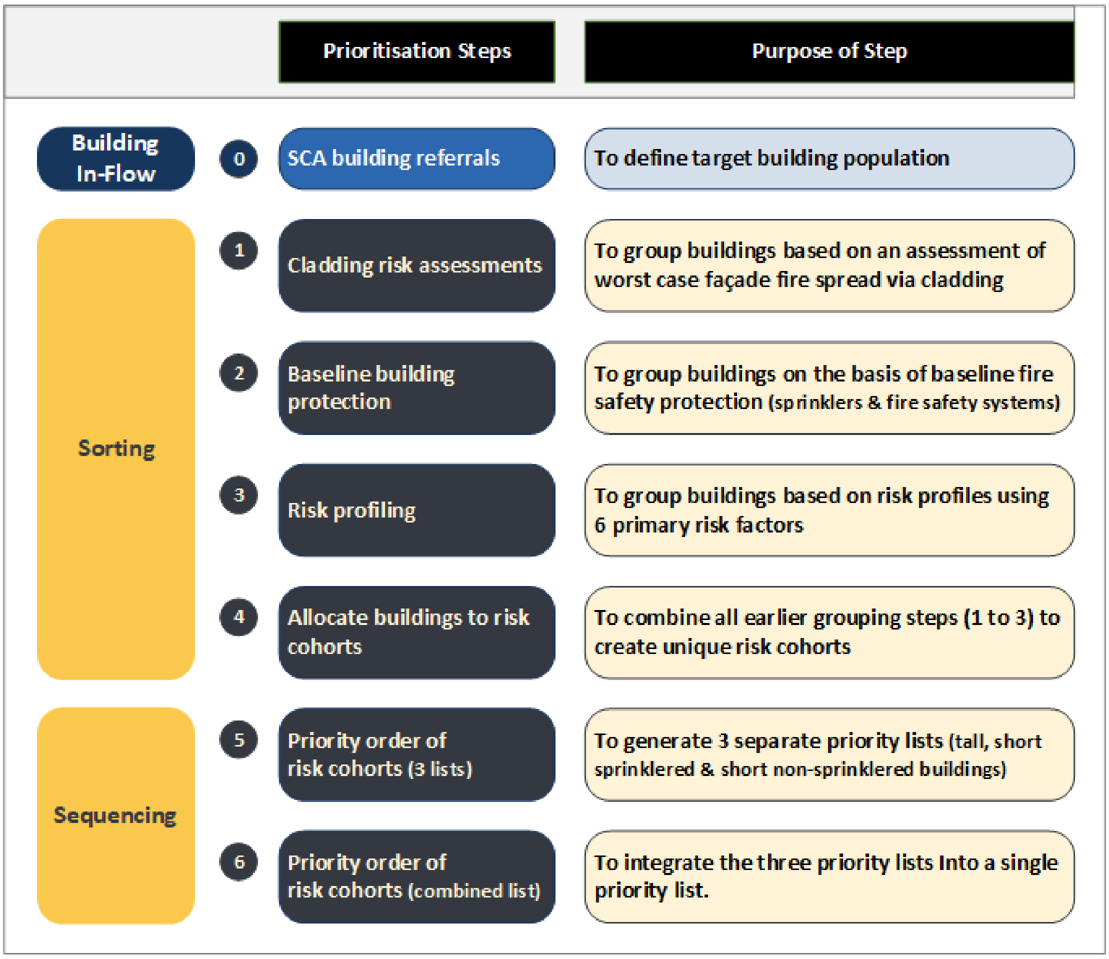
2. **All cohorts to be placed in priority order -** the **sequencing** phase

   The ordering of cohorts is determined on the basis of expert judgements about the difference in risk profiles between pairs of cohorts[8].

This approach was preferred as the data available for the buildings was limited and did not provide for simulation-based or other forms of quantitatively driven modelling.

The implementation of this modelling approach involved six discrete sorting and sequencing steps, as described at a high level in the diagram below.

These steps were applied to a base building population (**step 0**) established through the referral of buildings to CSV via the SCA.



The movement of buildings through the sorting and sequencing steps is illustrated in Appendix C.

[8] The rank position of the cohort determines the rank position of every building within the cohort.

5.1 Cladding risk assessments

CSV operates under a statutory mandate to lead and support endeavours that will address the heightened fire risk brought about by the use of combustible cladding on Victorian buildings[9].

CSV was established as an independent statutory entity on 1 December 2020. Clause 6 of the *Cladding Safety Victoria Act 2020*, stipulates a single objective for the organisation:

6 Object of Cladding Safety Victoria

The object of Cladding Safety Victoria is to support Victorians to rectify non-compliant or non-conforming external wall cladding products on buildings to improve the safety of those buildings.

This provides CSV with a clear and unequivocal focus on combustible cladding above other risk factors.

To support this end, the CRPM design incorporated a new risk measure (not available in earlier assessments) to estimate the fire risk posed specifically by combustible cladding on each building.

Concept of a Cladding Risk Premium

All buildings carry some level of fire risk. This is a key focus for ongoing regulatory compliance work to promote and enhance building safety.

Within the context of the broader regulatory framework for building safety, CSV's mission is to further the interest of building safety through a highly targeted and narrow focus on the escalation of fire risk caused by combustible cladding.

CSV's primary design principle for the CRPM (see section 2) was to:

- prioritise buildings where cladding could give rise to a relatively large facade fire; and
- deprioritise buildings where cladding could give rise to a relatively small facade fire.

As a general principle, the risk baseline for each building is represented by the risk profile of that building assuming no combustible cladding were in use, but all other aspects of the building are as they currently are.

Any subsequent measure of risk for CSV prioritisation purposes is focused on the risk premium or the risk elevation delta (p) – above baseline risk – created by the specific use of combustible cladding on each building.

The first function of the sorting and sequencing process, therefore, was to provide a measure of the risk posed by the presence of combustible cladding on a building facade. This allowed for the early identification of buildings where a worst case cladding fuelled fire spread has a plausible potential to produce a fire of a scale that would be difficult to control/contain and undermine safe evacuation.

The CRPM introduced a new measure of cladding risk, a maximum foreseeable loss measure that gives primacy to cladding specific risk above other risk factors.

This new CSV measure of the risk premium created by the presence of combustible cladding is the Initial Fire Spread in Cladding Assessment Number (IF-SCAN).

[9] Class 2 residential apartments and government-owned buildings.

What is the IF-SCAN?

The IF-SCAN is an estimate of:

The number of apartments[10] 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.

Fire Rescue Victoria (**FRV**), formerly Melbourne Metropolitan Fire Brigade (**MFB**), has responsibility as first responder for the majority of buildings that are subject to CSV assessment and funding prioritisation. The FRV role provides an important perspective on fire behaviour that is relevant to consideration of cladding's contribution to rapid fire spread. This perspective is pointedly articulated in the following account of the Lacrosse building fire that the MFB responded to in 2014.

> In 2014, MFB firefighters experienced one of our most significant encounters with combustible high-rise apartment cladding at the Lacrosse Apartment Building in Docklands.
>
> *In the early hours of 25 November 2014, a cigarette butt ignited a fire on an eighth floor balcony of the Lacrosse Building in Docklands. In the five minutes it took MFB firefighters to arrive on the scene, the fire had spread up six floors. The building's 500 residents were subsequently evacuated.*
>
> *Combustible material located in the external walls of the building caused the fire to spread rapidly along the outside of the building engulfing almost an entire side – from floors six to 21. Thankfully, no one was seriously injured.*

Source: Melbourne Metropolitan Fire Brigade, https://www.ourstorymfb.org.au/cladding

The IF-SCAN has been used to identify those buildings on which cladding could plausibly result in a facade fire of significant scale. It is a single measure for the entire building.

How is the IF-SCAN estimated?

The Cladding Risk Premium assessment is undertaken in two phases:

1. **Desktop assessment**

   For each building that is referred to CSV, a range of support documents are provided to inform assessments. This phase of assessment involves desktop visualisation of buildings using mapping software in concert with key documents, which include:

   - Architectural drawings;
   - Elevation Plans;
   - iAuditor Reports (a form of site inspection report, providing information relevant to a range of risk factors);
   - Advisory Reference Panel (**ARP**) Minutes – a record of deliberation by building safety experts that informs the risk rating of a building using the RAT; and
   - Core sample test reports.

2. **Field validation**

   Subsequent site inspections are essential to validate desktop based assessments and to provide for adjustments to IF-SCAN assessments where additional evidence makes such adjustment necessary.

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

There are three key steps to provide a quantitative estimate of the IF-SCAN.

1. **Select the worst case cladding ignition location**

   The CSV Expert Panel must determine the point on the building facade where an ignition could conceivably give rise to the largest facade fire spread via cladding[11]. For this assessment, the fire does not need to originate in cladding, but be capable of reaching cladding. The worst case location is the point where the fire first ignites cladding.

   This entails considering where the type, quantity and configuration (vertical/horizontal) of combustible cladding provides for the largest continued run of fire across the facade via cladding only. This places an emphasis on the selection of locations associated with extended vertical runs of cladding over multiple building levels.

2. **Determine whether the ignition of cladding is plausible at the selected location**

   A test of plausibility is essential to ensure that a building is not prioritised on the basis of a cladding ignition risk that is highly unlikely to eventuate.

   The CSV Expert Panel could only select a worst case cladding ignition location where a qualitative judgement indicated that ignition in cladding at the selected point was plausible.

   Consideration was given to **two key categories** of ignition threat: (i) threats manifesting at the ground-floor and basement typically from external sources; (ii) threats manifesting over the elevation of a building typically from SOU openings to the building facade.

   The Engineers Australia Society of Fire Safety provide examples of ignition sources that the CSV Expert Panel were able to consider.

   Example Design Fire Scenarios

Fire Scenario	Description
Internal Fire	Fire on floor plate
	Fire in the kitchen
	Fire on the balcony
External Fire	Fire in car underneath building facade/awning
	Fire in waste bins and skips
	Fires in external seating areas
Fire across the boundary	Fire in building across the boundary
	Bush fire event

   Source: *Society of Fire Safety Practice Guide Façade/External Wall Fire Safety Design, Engineers Australia: Society of Fire Safety, 7 Feb 2019*

   For further discussion about risk and plausibility refer to Appendix A.

3. **Estimate the number of apartments directly impacted**

   Combustible cladding has properties that allow a cladding fire to intensify, accelerate fire spread and so facilitate penetration of fire to internal structures/compartments.

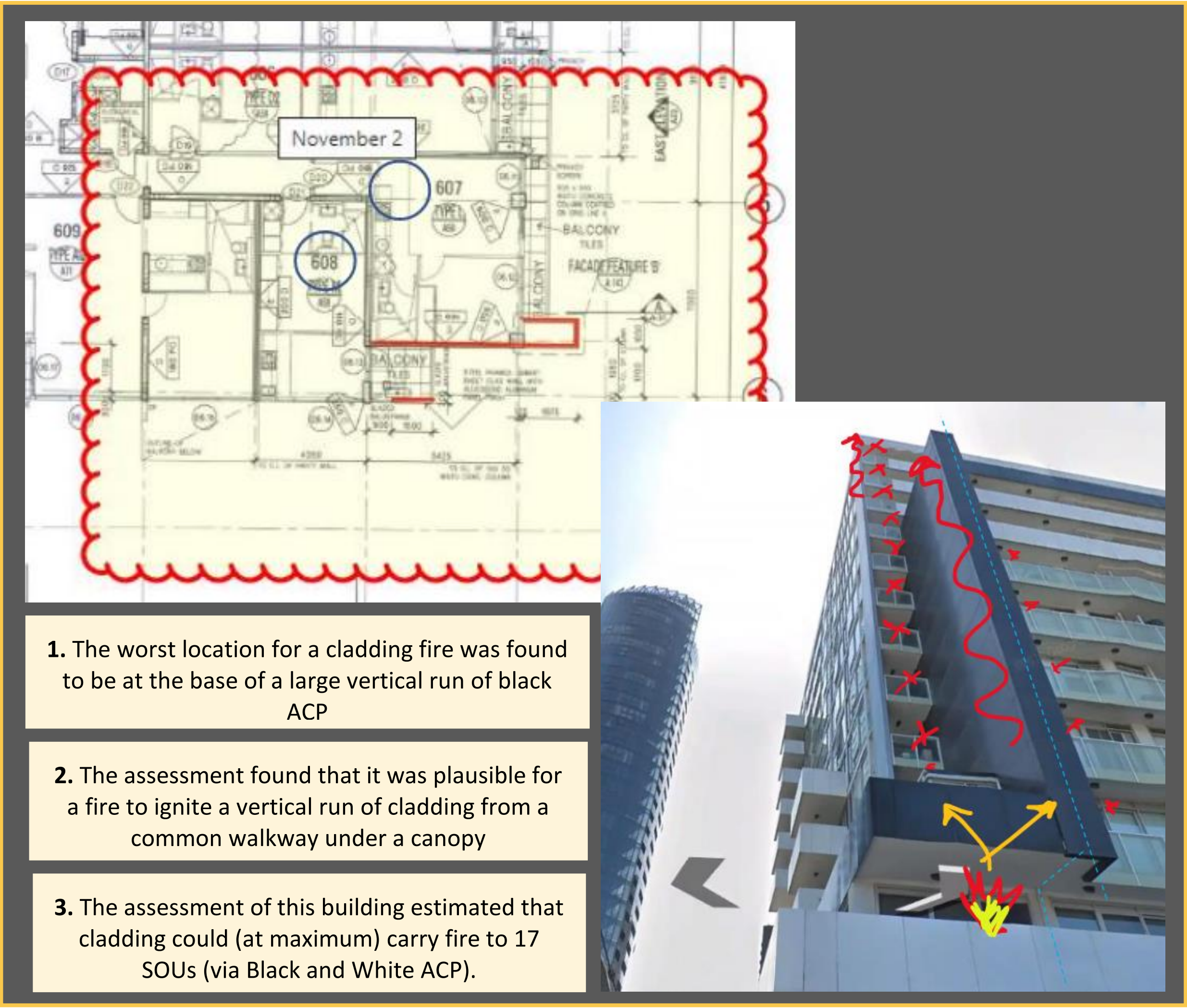
   The IF-SCAN is an indicator of the level of exposure (consequence) to the worst of these cladding properties. In that sense, this measure indicates the **extent to which combustible cladding is able to rapidly engage multiple SOUs** in a fire after it has become established.

   Having established the potential initial spread of fire across the cladding on a facade, the CSV Expert Panel uses architectural plans to relate that external spread to the internal apartments (or SOUs). The IF-SCAN is a count of the SOUs impacted by a worst case cladding fuelled fire spread across a building facade.

While these steps have the appearance of being sequential, they are interactive in reality. The practical experience of conducting these assessments has shown that it is no point selecting a worst case cladding ignition location in phase 1, only to render the fire implausible in phase 2.

[11] To do this, it is necessary to identify all areas of cladding on a facade that connect SOUs (cladding clusters) and determine which cladding cluster connects the highest number of SOUs.

An example of an IF-SCAN assessment is depicted below, showing how map imagery together with architectural drawings are used in a desktop assessment.



Further information about the assessment approach can be found in *Methodology for determining the Initial Fire Spread in Cladding Assessment Number*, prepared by the CSV Expert Panel.

The IF-SCAN is a conservative measure

As the IF-SCAN assessment is **THE** primary determinant of prioritisation, the assessments tend towards over rather that under estimation. For example:

- Where the estimate is initially recorded as a range (prior to validation), the maximum value in the range is used to represent the IF-SCAN; and
- Where the type of cladding is unclear, it is assumed a worst-type of cladding is in place.

As CSV is a fund limited program, it was important that areas of uncertainty were explored, and estimates adjusted accordingly. This underscores the importance of the field validation phase and the imperative to consider additional steps prior to a funding decision being made (e.g. core sample testing).

Consistency in IF-SCAN assessments

The assessment of the IF-SCAN is carried out by a dedicated CSV Expert Panel to ensure consistency in the matters considered and the judgements made.

This team has completed initial desktop Cladding Risk Premium assessments for over 400 buildings, in the period to August 2021 when this document was first published.

How is the Cladding Risk Premium used for prioritisation?

CSV funding prioritisation decisions have been guided by an understanding that a building with a higher IF-SCAN is considered to represent a **higher priority for rectification** than a building with a lower IF-SCAN.

To support CSV decision makers in their funding decisions, therefore, the CRPM separated the buildings into low and high risk buildings based on the IF-SCAN estimate.

This entailed establishing an IF-SCAN threshold that demarcates between lower and higher risk buildings from a cladding fire spread perspective. Before defining that threshold value, it was considered important to first contemplate whether different threshold values needed to be set for different types of apartment buildings.

The availability of an automatic sprinkler system is regarded as an important active safety feature of a building that aids in:

- Preventing an internal fire from reaching external cladding and from there spreading to multiple apartments via the facade; and
- Preventing an external fire from penetrating internally and spreading further within the building.

For these reasons, it was considered appropriate to set a lower threshold for non-sprinklered buildings.

The IF-SCAN thresholds adopted by CSV are tabulated below.

Sprinkler protection	High IF-SCAN (coded as "UPR")	Low IF-SCAN (coded as "LWR")
Sprinkler protected[12]	4 SOUs or more impacted	0 to 3 SOUs impacted
Limited or no sprinkler protection	3 SOUs or more impacted	0 to 2 SOUs impacted

Buildings that were assessed to have:

- A high IF-SCAN (coded as "UPR") were prioritised for assessment of funding eligibility and scheduled for full due diligence inspections to occur; and
- A low IF-SCAN (coded as "LWR") were de-prioritised in recognition that government funding for cladding removal/replacement is unlikely.

Other potential applications of the IF-SCAN measure

An option existed to use the IF-SCAN to separate buildings into more groups in order to consider additional types of safety-oriented intervention.

For example, those buildings assessed as having a low IF-SCAN (coded as "LWR") were able to be divided into two groups, being:

- Buildings with a moderate IF-SCAN of 2 to 3 (coded as "MID"); and
- Residual buildings with a very low IF-SCAN of 0 to 1 (remaining as "LWR").

The potential exists to explore other options to make buildings safer via other types of targeted intervention. Such solutions could target active and/or passive systems and may involve little or no cladding removal work.

Subsequent to the development of the CRPM, CSV did introduce a third level of risk rating. This is now reflected in the Victorian Government's Cladding Risk Mitigation Framework, which incorporates the following three cladding risk ratings:

- Unacceptable (associated with the CRPM coding "UPR");
- Elevated (associated with the CRPM coding "MID"); and
- Low (associated with the CRPM coding "LWR").

---

[12] The recorded RAT rating of sprinkler protection was used to determine the level of sprinkler protection for each building. A building is considered to be sprinkler protected if, at minimum, it is rated as "Fully sprinkled excluding balconies and canopies".

5.2 Baseline building protection

Once buildings had been sorted into high and low risk groups based on the IF-SCAN estimates (see section 5.1), buildings were separated further into groups to ensure that subsequent steps in the prioritisation process involved like-for-like comparisons of buildings.

When the framework for the CRPM was being designed, the CSV Expert Panel provided advice that comparing buildings on risk-based grounds is complicated by the fact that buildings:

- have very different structural attributes affecting their fire risk character; and
- are subject to very different fire safety compliance requirements with respect to the use and maintenance of active and passive fire protection systems.

A key function of the CRPM was to provide a means of differentiating between buildings on risk-based criteria. Given these stark differences within the CSV building population, a legitimate question to ask is:

How can one reasonably compare a low-rise building with no sprinkler protection and relatively unprotected escape routes to a skyscraper with elaborate active and passive systems and secured and contained stairwells?

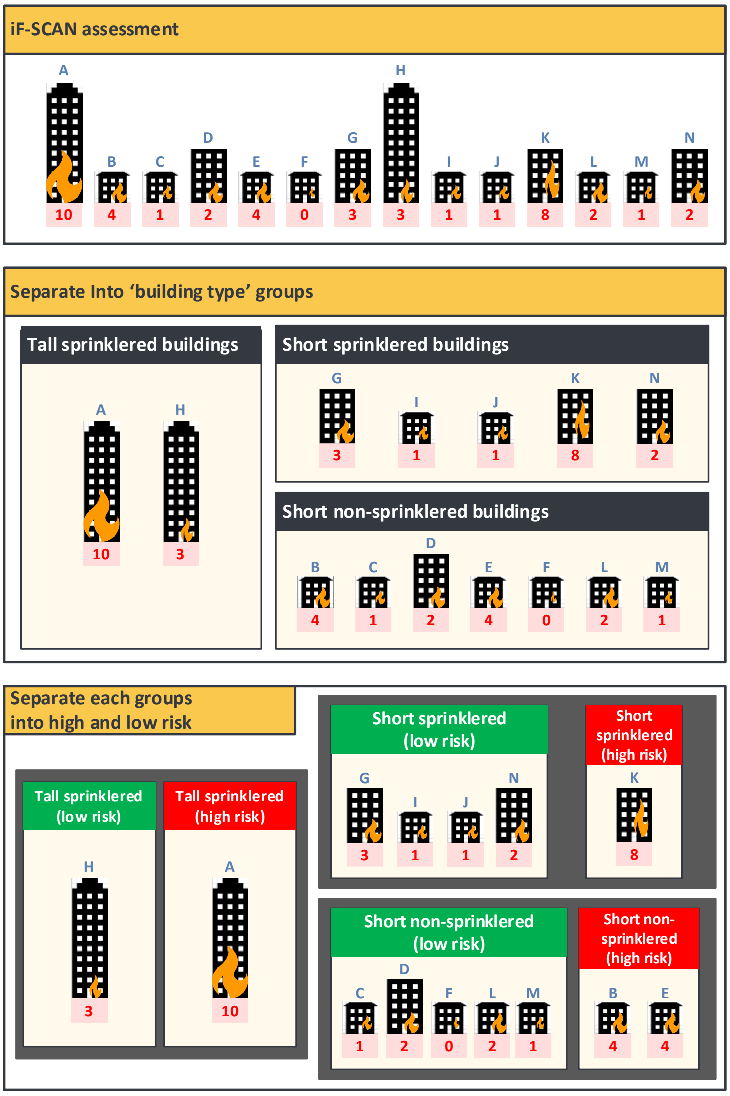
In response to this question, it was decided that risk comparisons could be most meaningfully made between buildings that shared fundamental building protection characteristics.

To ensure that "like-for-like" judgements underpin the prioritisation process in the modelling, it was decided that buildings should be prioritised separately based on:

- building height (buildings > 25 metres are required to have sprinklers systems installed and maintain extensive fire safety systems); and
- presence/absence of sprinklers (buildings < 25 metres often proactively deploy sprinkler systems, which changes the risk profile for such buildings).

The CRPM approach groups buildings on this basis before further prioritisation steps.

This grouping process is illustrated on the right. The red numbers reflect indicative IF-SCAN estimates to aid illustration.

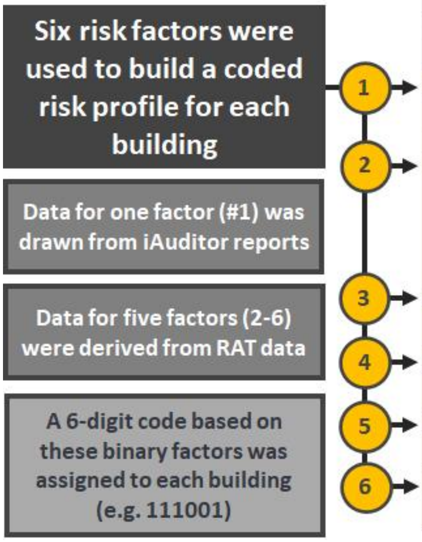


5.3 Risk profiles

Another important step in the sorting phase was the identification of a risk profile for each building using information available about other risk factors (in addition to the IF-SCAN).

The table below shows the:

- six risk factors that were used to develop a coded risk profile;
- the values recorded for each risk factor available in source data; and
- binary rating scale applied to each risk factor.



Variable	Variable values	Binary risk (0 = low risk, 1 = high risk)
Exit Risk	> 1 exit OR no cladding around exit	0
	only 1 exit AND cladding around exit	1
Type of cladding present	≤ 30% PE content ACP ≤ 10% PE content ACP	0
	Expanded polystyrene ACP PE ACP unclear	1
Fire fighting provisions	Very good, good	0
	Fair, poor	1
Speed of evacuation	Very good, good	0
	Fair, poor	1
Egress provisions	Very good, good.	0
	Fair, poor.	1
Number of occupants/SOUs	1-150 units OR 1-450 occupants	0
	151+ units OR 451+ occupants	1

Variables were selected that would serve as key indicators of the extent to which the safety features of a building compromise fire suppression or render safe evacuation difficult.

To undertake this risk profiling task, CSIRO Data61 guided by expert advice from the CSV Expert Panel:

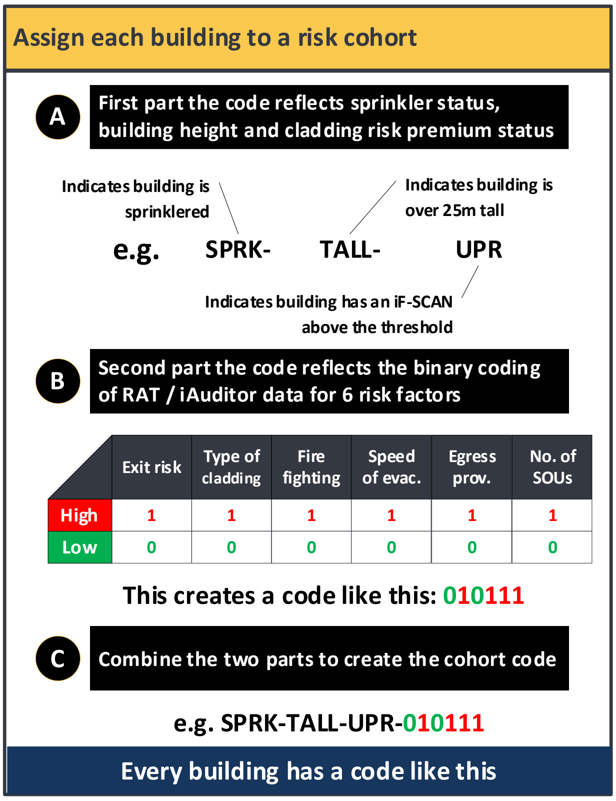
- identified six risk factors (five of which were drawn from the 18 assessed in the RAT), which could be used to differentiate buildings on the basis of risk, have well-formed ordinal scales and represent broadly unique measures of an important risk dimension.
- introduced a binary scale for each of the six risk factors (**1** = high risk and **0** = low risk) based on the input scores for these variables.
- created a binary code for each building (e.g. 101010) to represent the rating outcome, where:
  - ✓ a binary code of 111111 means that a building is rated high risk for all six risk factors;
  - ✓ a binary code of 000000 means that a building is rated low risk for all six risk factors; and
  - ✓ a binary code of 010101 means that a building is rated high risk for three risk factors and is rated low risk for the other three risk factors.

These six digit codes comprise one part of the label attached to the risk cohort to which a building is assigned. See section 5.4 for further information about risk cohort coding.

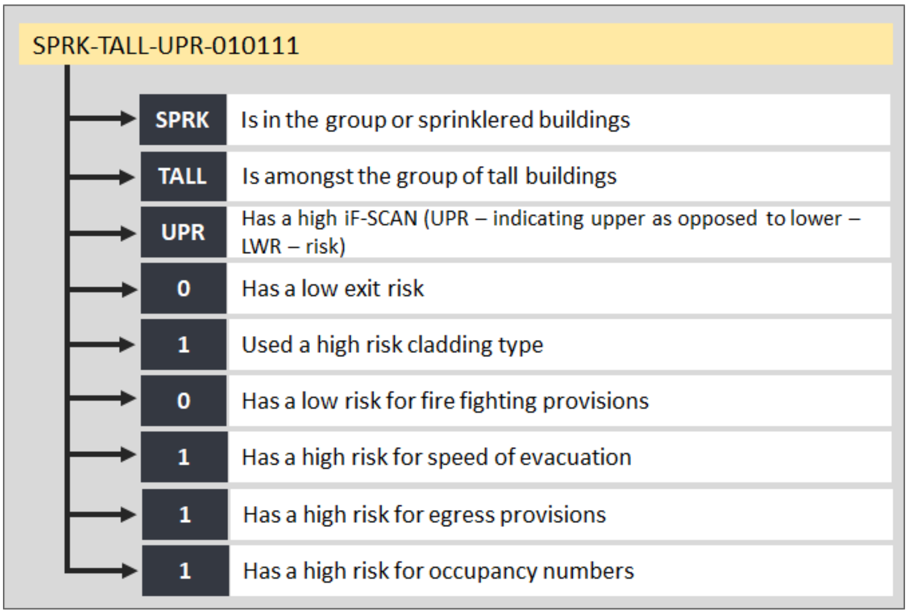
5.4 Risk cohort coding and building allocation

Using all information compiled over the preceding steps, a risk cohort code was assigned to each building.

The construction of the risk cohort code and its constituent elements is illustrated below.



A sample code and its risk attributes are presented below.



There were 81 unique codes generated for the 400 buildings assessed to 31 May 2021.

Amongst the 81 unique risk cohort codes, there were some codes with only one building and many codes with more than one building. The most buildings sharing a single code was 29. Buildings with the same code share the same risk profile under this model and have the same ranking priority.

5.5 Priority risk cohort lists (by building group)

The first sequencing step in the CRPM process involved ordering risk cohorts from 1 to *n*., with the:

- 1st risk cohort selected considered to have the highest risk of all risk cohorts; and
- last (*nth*) risk cohort selected considered to have the lowest risk of all risk cohorts.

It is important to note that the IF-SCAN estimate (see section 5.1) was only used to categorise buildings as higher (UPR) or lower (LWR) risk and does not influence this sequencing step. Those cohorts with a rating of UPR will **ALWAYS** be above risk cohorts with a rating of LWR.

This sequencing step was carried out separately for the six groups of buildings (each cohort in a group share the same start to their cohort code):

1. Tall sprinklered buildings with a high IF-SCAN (SPRK-TALL-UPR);
2. Tall sprinklered buildings with a low IF-SCAN (SPRK-TALL-LWR);
3. Short sprinklered buildings with a high IF-SCAN (SPRK-SHOR-UPR);
4. Short sprinklered buildings with a low IF-SCAN (SPRK-SHOR-LWR);
5. Short non-sprinklered buildings with a high IF-SCAN (NSPRK-SHOR-UPR); and
6. Short non-sprinklered buildings with a low IF-SCAN (NSPRK-SHOR-LWR);

This created six priority lists of building cohorts. The priority order was built one cohort at a time using the Logical Ranking Method developed by CSIRO Data61, as described in section 0.

A prioritised list of risk cohorts for tall sprinklered buildings with a high IF-SCAN (SPRK-TALL-UPR) is shown below.

Create a priority sequence for the risk cohorts

- **The sorting process is carried out separately for each of the 6 groups (i.e. all buildings in a sorting process have the same start to their codes (e.g. SPRK-TALL-UPR).**
- **An expert group ranks the cohorts based on the risk represented by the 6 risk factors (captured by the code 010111)**

The cohort sequence for tall sprinklered buildings with a high iF-SCAN is shown in the table

It covers 19 buildings

Cohort Codes	No. of Buildings
SPRK-TALL-UPR-011111	8
SPRK-TALL-UPR-011110	1
SPRK-TALL-UPR-011011	2
SPRK-TALL-UPR-011010	1
SPRK-TALL-UPR-010111	1
SPRK-TALL-UPR-010011	2
SPRK-TALL-UPR-011101	1
SPRK-TALL-UPR-011100	1
SPRK-TALL-UPR-010100	1
SPRK-TALL-UPR-001111	1

This is 1 of 6 priority cohort sequences

The highest ranked risk cohort code comprises eight buildings, each sharing the same risk profile.

Types of ranking decisions

In determining the priority order of risk cohorts, two types of decision are required:

Logical ranking decisions	**'Trade off' ranking decisions**
011111 011011 Logically strict	010111 011011 Relative importance of risk factors
Consistent with dominance rule described by CSIRO Data61, the first cohort MUST precede the second. That is because: ▪ both cohorts have high risk ratings for the 2^{nd}, 3^{rd}, 5^{th} and 6^{th} risk factors; ▪ both cohorts have low risk ratings for the 1^{st} risk factor; BUT ▪ the first cohort is rated high for the 4^{th} risk factor while the second cohort is rated low for that risk factor. Logically, the first cohort MUST be ranked higher than the second cohort.	These two risk factors have differences that extend to more than one risk factor: ▪ both cohorts share the same risk rating for the 1^{st}, 2^{nd}, 5^{th} and 6^{th} risk factors; ▪ the first cohort has a <u>higher</u> risk rating than the second cohort for the 4^{th} risk factor (speed of evacuation); and ▪ the first cohort has a <u>lower</u> risk rating than the second cohort for the 3^{rd} risk factor (fire fighting provisions). To rank these cohorts, the decision maker needs to decide whether inferior fire fighting provisions adds more or less to overall risk than inferior speed of evacuation provisions.

As it turns out, the answer to the trade-off question presented in the table above differs according to which group of buildings is involved. The CSV Expert Panel concluded that firefighting provisions have an increased importance for tall buildings, and evacuation/egress has an increased importance for short buildings. This difference in prioritisation thinking is explained in the table below.

Tall buildings
Fire fighting provisions <u>more important than</u> speed of evacuation.
In tall buildings, fire fighting plays a greater role in coordinating evacuation and building structure (fire enclosed stairs/smoke isolation) provides refuge for those evacuating a building that is superior to that available in short buildings.

Short buildings
Speed of evacuation <u>more important than</u> fire fighting provisions.
In short buildings, there is added importance in evacuating people quickly as they generally have open stairs (not fire isolated) and unprotected paths of egress. When fire fighting services arrive, ground based fire fighting is generally more feasible for short buildings compared to tall buildings.

The different weighting accorded to different risk factors for alternative groups of buildings demonstrates the importance of ranking each group of buildings separately.

Future sequencing decisions

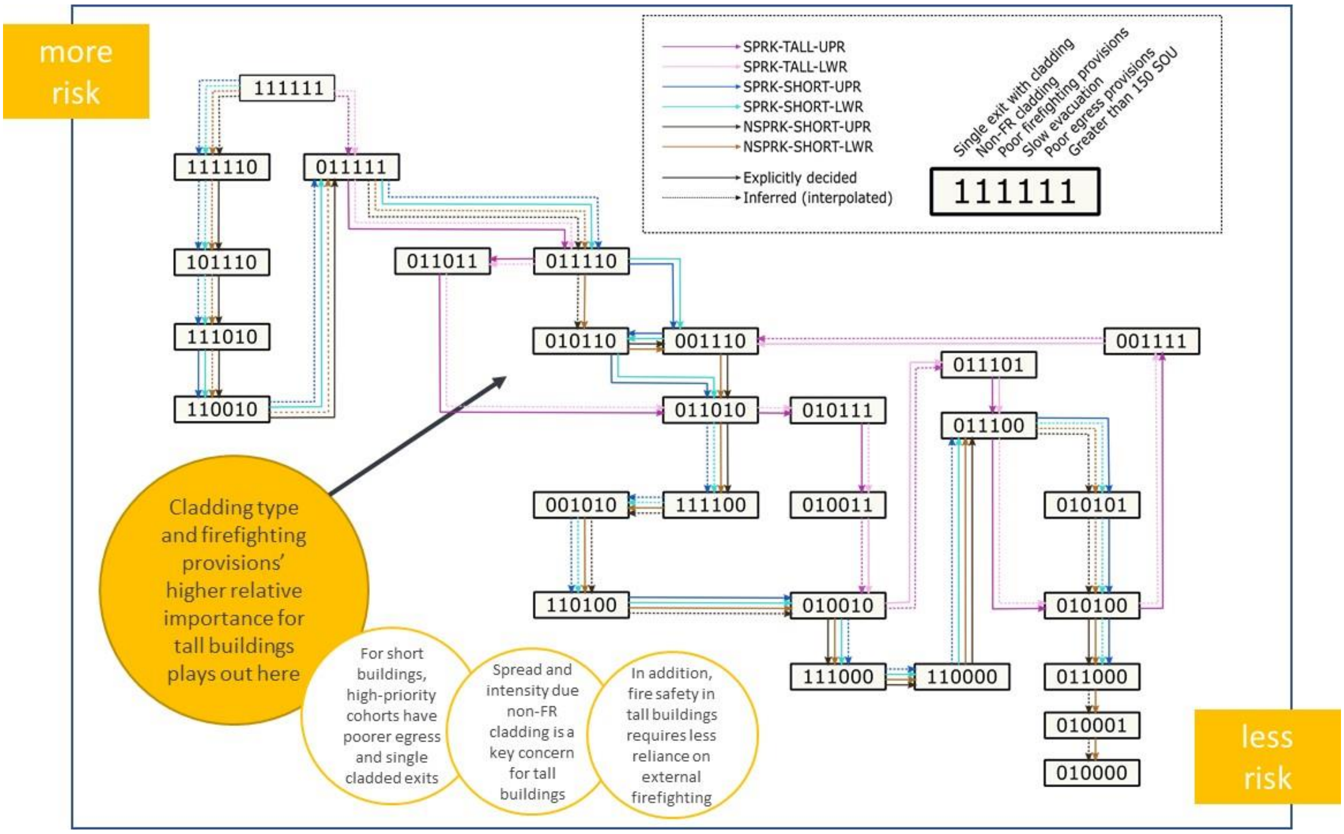
There are 384 possible cohort codes (6 x 2^6) that can be generated using this number of building groups (6), risk factors (6) and a 2-point risk factor scale.

Across 400 buildings assessed to May 2021, there had been 81 unique risk cohort codes observed. As new buildings are assessed over time, codes that have not emerged previously have been identified. An important task of CRPM management has been to allocate all new risk cohort codes a place within the existing cohort rankings, consistent with the ranking history that has already developed.

CSIRO Data61 has created a map of the cohort pathways across cohort codes that illustrate:

- where a common priority order applies to risk cohorts irrespective of which group of buildings is involved; and
- where the priority order diverges for one group of buildings, relative to the pathway observed for other groups of buildings.

This provides a means of observing and reviewing past risk cohort sequencing decisions. It also serves as a valuable tool for considering the placement of new risk cohorts within the existing sequence.



5.6 Priority lists (combined)

The preparation of three separate priority lists provided a sound way of enforcing like-for-like risk comparisons and for breaking down risk data and prioritisation decisions into manageable components.

Working with three separate lists, however, is cumbersome in application. An administrative decision was therefore made to merge the three prioritised lists to provide a single point of CRPM reference for CSV planning and fund prioritisation decision-making.

6 Risk variable selection

In developing the CRPM it was necessary to select a set of risk variables that would in combination provide for buildings to be differentiated from one another on risk-based grounds.

The introduction of a new measure, the IF-SCAN (see section 5.1), positions cladding as the primary risk differentiator, consistent with the CRPM design principles (see section 2). However, the IF-SCAN, as applied by CSV, only provides for buildings to be separated into two or three groups (high and low risk OR high, medium and low risk) through the specification of SOU impact thresholds linked to facade fire spread.

A further set of variables were therefore required that would provide for another level of risk-based discrimination amongst:

- all buildings that share an IF-SCAN risk rating of high (code “UPR”); and
- all buildings that share an IF-SCAN risk rating of low (code “LWR”).

Having already established the level of fire spread risk posed by combustible cladding, the selection of further risk variables was intended to identify structural attributes of each building that were likely to exacerbate the threat of cladding risk by:

- confounding or thwarting efforts to suppress a fire once started; and/or
- compromising building egress and making safe evacuation untenable.

For the purpose of the CRPM, a **risk variable** is a single measurable attribute of a building that contributes towards the understanding about how the risk posed by cladding **is escalated** by the quality and coverage provided by other building safety features.

The development of the CRPM proceeded on a clear understanding that the buildings requiring prioritisation are already with CSV. This provides a degree of urgency, necessitating that the CRPM must make optimal use of the available building risk data, and not defer prioritisation modelling unduly while an improved/enhanced building risk dataset is compiled.

That is not to say that efforts to extend and improve the CRPM should not be pursued, and CSV has accordingly continued a process of review to provide for model enhancement within the scope of CSV’s building rectification charter.

The selection of variables for use in the CRPM was informed by:

- a number of core data considerations (see section 6.1); and
- the current availability of data, principally through the RAT (see section 6.2).

The influence of other risk variables on prioritisation decision making that are not incorporated in the CRPM is described in section 0.

6.1 Data considerations

The selection of risk variables for use in the CRPM favoured variables that:

▪ offered a sound basis for discriminating between buildings;	There is no point in selecting a variable where all or most buildings have the same rating.
▪ reliably represented the distribution of risk values within a risk dimension;	There is no point in selecting a variable where the rating is unknown or unclear for many buildings.
▪ uniquely represented one element of risk; and	There is no point selecting a variable to represent a risk dimension that is already measured by another variable.
▪ represented structural rather than behavioural aspects of building safety.	There is no point selecting a variable that measures a temporal risk element, for which today’s rating could change tomorrow.

Variables with low discriminatory power

The CRPM development focussed on the identification of risk variables that would help to **discriminate between buildings**. So, there is no point in selecting a risk variable for inclusion for which all (or nearly all) buildings rate the same for that risk variable – one example of this is the RAT variable that identifies the building class, for which all buildings of interest to CSV are rated the same (i.e. Class 2).

Variables with low reliability/representability

When a risk variable is selected, there needs to be a good level of certainty that the distribution of ratings for that variable is a reliable representation of that risk dimension across the building pool. For five of the 18 risk variables measured using the RAT, there is an option to rate the risk as "unclear" or "unknown". Buildings with this rating are given the highest rating possible for the variable and it cannot be determined from the coding which are genuinely high risk and which are unclear/unknown.

Variables that uniquely represent risk

To the extent possible, each risk variable should provide a measure of a unique dimension of building risk. It is not ideal to have more than one risk variable measuring the same safety attribute. For example, the requirement to protect a building with sprinklers is a function of building height, so sprinkler use and building height are highly correlated – providing a level of double counting for a single risk dimension.

Variables associated with temporal/behavioural risk

A building's fire risk is influenced by both:

- The way it has been constructed (structural risk); and
- The way that fire risk is managed (behavioural risk).

Construction planning and implementation requires long lead times and so, the risk modelling must produce priority rankings that are stable over time. Accordingly, the modelling will not consider fire safety practices (behavioural risk elements), which can change over time.

These behavioural elements remain very important but must remain the preserve of regulatory compliance initiatives that can operate in parallel to CSV funded rectification work.

Scale of variable measurement

Ideally, on each risk variable it should be possible to split the buildings into two or three groups (high and low risk; or, high, medium and low risk). A low/high demarcation was preferred initially because it reduced the complexity of ranking analyses.

6.2 RAT data

The major existing building risk data source available for use in the CRPM was the RAT data. While the RAT data had limitations, it served as an important foundation element for the CRPM.

The **DELWP (now DTP) guidance materials** for the RAT define the Tool's limitations:

- The Tool is **not intended** to guide **long term rectification** or **compliance** with the National Construction Code.
- The Tool provides a consistent method for the **initial assessment** of buildings with combustible cladding and assigns them a risk category on a building by building basis.
- The Tool is **not intended** as a **substitute for expert judgement**.
- The **Tool** has been designed to support practitioners by providing a **starting point** for them to take note of the elements of a building that contribute to the risk of a cladding fire.

Appreciating these limitations, CSV's approach was to draw informedly on the RAT information to develop a method for the risk-based prioritisation of rectification works.

The table below lists each of the 18 RAT variables and a note in the rightmost column to identify how the variable was incorporated in the CRPM and, if not, the rationale for non-selection.

Appendix D contains a full description of each RAT risk criterion. Also included in Appendix D is a tabulation of the distribution of RAT values for each of the 18 RAT criteria to demonstrate the variability of ratings.

	Risk Criteria	Criteria Values	CRPM selection decision
1	**Building/ occupancy type**	▪ Class 9a or 9c building or a building where occupants otherwise need assistance in evacuation ▪ Class 2, 3, 9b building ▪ Class 4, 5, 6, 7, 8 buildings	Not selected. No discriminatory power. All buildings have the same value for this variable
2	**Number of occupants / sole occupancy units**	▪ 1-10 units ▪ 11-50 units ▪ 51-150 units ▪ 151+ units ▪ 1-30 occupants ▪ 31-150 occupants ▪ 151-450 occupants ▪ 451+ occupants	Selected as risk factor 6 of 6. Provides an important measure of threat to life (consequence), through the quantification of occupancy scale.
3	**Types of combustible cladding present**	▪ Expanded polystyrene ▪ ACP PE ▪ ACP unclear ▪ ≤30% PE content ACP ▪ ≤10% PE content ACP	Selected as risk factor 2 of 6. While discriminatory power is low for this variable, knowledge of FR cladding is a useful input to prioritisation
4	**Automatic suppression (sprinklers)**	▪ No sprinklers ▪ Basement carpark only ▪ Protecting exit paths only ▪ Fully sprinkled excluding balconies and canopies ▪ Fully sprinkled including SOU's, balconies and canopies	Not selected. This variable has already informed prioritisation through building grouping undertaken during the sorting phase (see section 5.5).
5	**Extent of combustible cladding**	▪ 50-100% coverage ▪ 25-50% coverage ▪ 0-25% coverage or decorative element only	Not selected. This variable is redundant, replaced by the IF-SCAN assessment (see section 5.1)
6	**Configuration of combustible cladding**	▪ Unbroken vertical cladding ▪ Unbroken horizontal cladding ▪ Broken vertical cladding ▪ Broken horizontal cladding	Not selected. This variable is redundant, replaced by the IF-SCAN assessment (see section 5.1
7	**Proximity of combustible cladding to potential ignition sources**	▪ Extreme ▪ High ▪ Moderate ▪ Low	Not selected. This variable is redundant, replaced by the IF-SCAN assessment (see section 5.1)
8	**Fire rating of external walls (behind cladding)**	▪ Unclear ▪ No ▪ Yes	Not selected. 86% of ratings are no or unclear

	Risk Criteria	Criteria Values	CRPM selection decision
9	**Risk of combustible cladding fire to or from adjacent buildings**	▪ < 3m distance ▪ > 3m distance ▪ > 6m distance ▪ > 10m distance	Not selected. Adjacent building proximity cannot be related to the worst location used for the IF-SCAN assessment (see section 5.1) This factor is flagged on priority lists as a risk factor of interest outside the CRPM (see section 0).
10	**Windows, doors, or other openings adjacent to combustible cladding**	▪ Yes ▪ No	Not selected. No discriminatory power. 99% of buildings have the same value for this variable
11	**Insulation type behind combustible cladding**	▪ No additional insulation ▪ Mineral fibre ▪ Rock wool ▪ Glass wool ▪ Sheep wool ▪ Plastics (EPS, Polyester, Phenolic) ▪ Unclear	Not selected. Unreliable indicator. 85% of ratings are associated with the composite value "Sheep wool, Plastics (EPS, Polyester, Phenolic) OR Unclear" and it expected that the actual rating for many of these buildings is 'unclear' as the assessment requires getting behind the cladding.
12	**Fixing method**	▪ Mechanical ▪ Other or Unclear	Not selected. Unreliable indicator. 50% of the ratings are in the category "Other or Unclear". In numerous due diligence inspections, CSV has found that nearly all building have mechanical fixings, suggesting that this variable is not reliable as a discriminator.
13	**Egress provisions**	▪ Very Good ▪ Good ▪ Fair ▪ Poor	Selected as risk factor 5 of 6. Provides an important overarching measure the capacity to get fire suppression resources into a building and people out.
14	**Speed of Evacuation**	▪ Very Good ▪ Good ▪ Fair ▪ Poor	Selected as risk factor 4 of 6. The rapid spread of cladding fuelled fires makes it vital that the structural aspects of a building do not retard quick evacuation.
15	**Fire fighting provisions**	▪ Very Good ▪ Good ▪ Fair ▪ Poor	Selected as risk factor 3 of 6. The rapid spread of cladding fuelled fires makes it vital that a fire fighting response can be initiated quickly and effectively.

	Risk Criteria	Criteria Values	CRPM selection decision
16	**Active systems connected to a monitoring agency.**	▪ Yes ▪ No/unclear	Not selected. Temporal indicator. An underpinning CRPM design assumption is that the upgrade of active systems can be expedited through established regulatory mechanisms and not via a funded capital works program.
17	**Essential safety measure maintenance**	▪ Very Good ▪ Good ▪ Fair ▪ Poor	Not selected. Temporal indicator. An underpinning CRPM design assumption is that the enhancement of ESM maintenance can be expedited through established regulatory mechanisms and not via a funded capital works program.
18	**Building management, 24/7 onsite security or warden system**	▪ Not clear ▪ No ▪ Part time ▪ Yes	Not selected. Temporal indicator. An underpinning CRPM design assumption is that improvement in onsite security measures can be expedited through established regulatory mechanisms and not via a funded capital works program.

Exit risk

One other risk variable was introduced that is not included amongst the RAT variables.

The CSV Expert Panel was particularly concerned by buildings that relied on a single exit for egress, where that exit had exposure to combustible cladding (either immediately around the exit opening or proximate to the pathway via which those escaping the building exit would move).

This risk variable was able to be coded using desktop mapping visualisation and specific information recorded in iAuditor Reports.

Exit risk was selected as risk factor 1 of 6.

6.3 Other variables of interest

CSV has not relied exclusively on the CRPM to make funding prioritisation decisions.

Models like the CRPM provide a useful tool to aid such decisions but cannot fully capture the unique nature of each building and the complexity of fire risk specific to that building.

In the early phases of engagement and review with Victoria's building safety regulator, the Victorian Building Authority (**VBA**), other risk factors were flagged that are a focus for the VBA in their ongoing regulatory work. In particular, reference was made to heightened risk associated with:

- Load bearing timber frames used in low-rise buildings, with concern expressed that a significant cladding fire may penetrate the internal structure, which could contribute to building collapse; and
- The threat posed to and by adjacent buildings where other buildings are in close proximity.

While the data is not available to include these risk variables reliably within the CRPM, CSV has recognised these risk features as areas of regulatory concern.

The prioritised building lists generated using the CRPM, therefore included two flags to identify:

- A low-rise building with a timber frame (obtained through an CSV Expert Panel review of architectural drawings); and
- A building that is within three metres of an adjacent building.

The due diligence/ground truthing phase of the CSV processes provides an opportunity for risk considerations that are not part of the CRPM to influence judgements about building fire risk. This includes but is not limited to buildings that are located in areas of heightened bushfire risk.

These risk considerations become a point of focus for due diligence inspections and field validation exercises that form part of the IF-SCAN assessment (see section 5.1). Any information captured during the due diligence phase is made available to CSV to inform decisions about funding priorities.

7 Associated documents

This document is part of a set of three related documents, and should be read in conjunction with:

- the CSIRO Data61 paper, *A risk prioritization method for residential buildings with combustible cladding: A Report for Cladding Safety Victoria* (see B.02 – Risk Prioritisation Method); and
- the CSV Expert Panel paper, *Methodology for determining the Initial Fire Spread in Cladding Assessment Number* (see G.02 – IF-SCAN Procedure/Method).

Appendices

Appendix A: Assessing plausibility in a risk context

In a risk-based assessment process like the one developed through the CRPM, the true interest is in the likelihood of cladding ignition. With limited data available about fire ignition in relation to cladding, the quantitative representation of cladding ignition likelihood cannot be reliably computed.

Ample historical fire incident data exists about structure fires that do not involve combustible external cladding. This provides a rich knowledge bank of those ignition sources that are most likely to contribute to structure fires. Where cladding is not proximate to high incident ignition sources, the CRPM assumes that the likelihood of cladding ignition is close to zero, and an ignition involving cladding is therefore considered implausible.

In a paper on the use of a plausibility concept within risk analysis[13], the authors reviewed many definitions and applications of a plausibility concept within a risk context. It was observed that applications of the plausibility concept are prevalent in scenario based and future analyses where risk forecasting is a focus, and also in risk response domains that are designed in keeping with the precautionary principle.

In that paper, risk is defined as a product of consequence (C) and uncertainty (U) and the uncertainty dimension of risk can be conceived of as a scale encompassing the probable, plausible and possible. A focus on plausibility as a measure of uncertainty brings a focus to two key aspects of risk: likelihood and knowledge.

When applied in the CRPM context, a plausibility assessment requires:

- A judgement of the likelihood of an ignition (informed by the knowledge of ignition events); and
- A judgement about the strength of the knowledge that supports the assessment of likelihood.

The accumulated expertise available to CSV in support of the CRPM and the concentrated focus on cladding fire risk over four years provides a strong foundation for these judgements to be made.

Risk strategies and methods that employ the plausibility concept are found in prominent Australian Government domains, as reflected in:

- National Emergency Risk Assessment Guidelines (**NERAG**), developed to support Australian disaster resilience planning[14] and reflected in emergency management planning in Victoria[15]; and
- Environmental Health Risk, to consider the impact of environmental hazards on human health[16].

Plausibility centric judgements about uncertainty are considered justified in a combustible cladding risk domain where cladding ignition data is not extensive, but knowledge of the major ignition causes in structure fires is available and sufficient expert knowledge about cladding and building safety is available to apply to the risk assessment process.

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[13] *The concept of plausibility in a risk analysis context: Review and clarifications of defining ideas and interpretations*, I.Glette-Iversen, T.Aven & R.Flage, 2022.

[14] Australian Disaster Resilience Knowledge Hub (https://knowledge.aidr.org.au/resources/strategic-disaster-risk-assessment-guidance/).

[15] *Emergency risks in Victoria*, Victorian Government Department of Justice and Community Safety, July 2020.

[16] *Environmental Health Risk Assessment – Guidelines for assessing human health risks from environmental hazards*, www.health.gov.au, June 2012.

Appendix B: CSIRO explanation of risk use in the CPRM

The content below is a direct extract from the CSIRO Data61 technical document that explains the method and approach used to develop the CRPM.

It was copied from the CSIRO document entitled *A risk prioritization method for residential buildings with combustible cladding: A Report for Cladding Safety Victoria* (June 2021).

Classically, risk is *expected loss* and in the case of events that may happen once or more over time this becomes either the *long-run average loss per unit time* or some other long-run metric over a loss per unit time probability function (such as the 95th percentile). In this sense we require *event likelihood* and *event consequence* information, and quantifying risk involves estimating these values and then multiplying them together and summing the result over the set of possible events (in cases where we are dealing with a finite set of events). In the context of residential buildings we would have great difficulty in quantifying likelihood (as rates of occurrence) and consequence (in holistic units of loss such as money or life-years):

1. Enumeration of prospective ignition points on/in a building is a laborious manual process and does not scale over a program of hundreds of buildings. AI-based approaches in theory may be applicable in this regard but would require many person months or years to design, develop and validate to a sufficient standard.
2. Some observational data is available about fire ignition rates at different characteristic locations (e.g., kitchens or balconies). Practitioners with knowledge of building fire have intuitive understandings of relative likelihoods of ignitions. This data and knowledge is not sufficient however for reliably and repeatably evaluating with some quantitative accuracy the likelihoods of ignition events at various potential ignition locations for specific buildings.
3. Estimating the consequence of an ignition, or moreover, of numerous potential ignition points over every specific building of interest, is not a practical. This is because of shortcomings in data availability, software, and in relevant science.

In the combustible cladding context, the minimization of expected loss is not necessarily the foremost aim of the Victorian Government and CSV. Reeling-in the maximum foreseeable loss, to avoid major catastrophes, is closer to the true intentions. For all of the aforementioned reasons, we seek a risk prioritization approach which:

1. Focuses on the ignition points on/in buildings which could lead to the largest of combustible cladding fires on the façade these buildings.
2. Collapses the domain of likelihood into a binary choice of {implausible; *plausible*} and therefore considers all of the plausible ignition points for cladding on a building façade as being broadly equivalent from a likelihood perspective.
3. Simplifies consideration of the process of escalation from an ignition to a façade fire, to one where the escalation is assessed as being a { *implausible*; *plausible* } binary choice, and only considered *implausible* in cases where sprinkler systems such as “drenchers” are essentially guaranteed to extinguish an ignition.
4. Estimate the consequence of an ignition according to simplified measures which can be assessed in a reliable and repeatable way by building fire practitioners; which for this work becomes a measure of the maximum foreseeable extent of combustible cladding consumption in a façade fire from a *plausible* ignition and fire escalation point on each given building.

To elaborate on the last of these points, the (worst case) consequence of an ignition was estimated by an SME panel in terms of the **maximum number of Single Occupancy Units (SOU) that could be involved in a facade fire**; or in short, the **maximum SOU**[17].

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[17] An SOU is a well understood concept in the building industry, and in more common language is synonymous with the number of apartments in a multi-tenancy residential building.

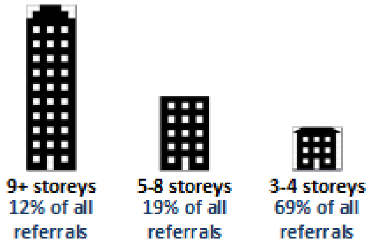
CLADDING SAFETY Victoria

Cladding Rectification Program

Risk Prioritisation Modelling – Process Flow

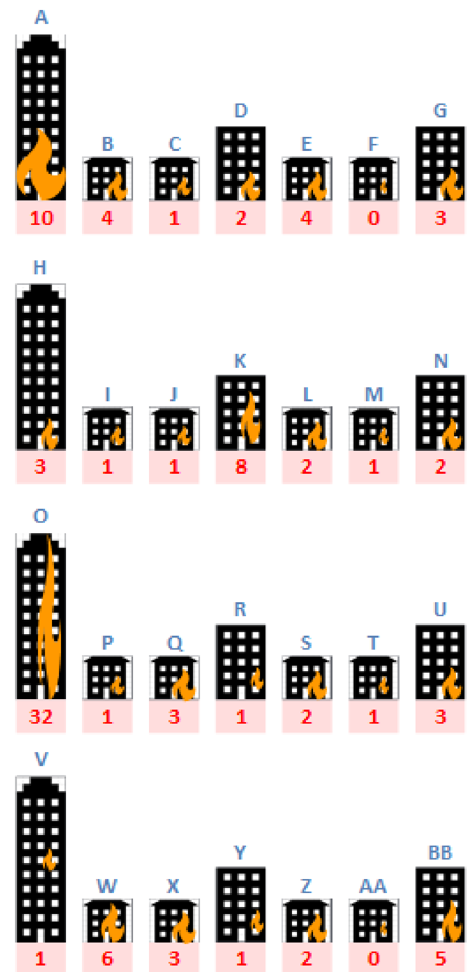
1 Buildings referred to CSV

- Referred via State-wide Cladding Audit
- Only buildings with a RAT rating of extreme or high
- Mix of high, medium and low rise buildings



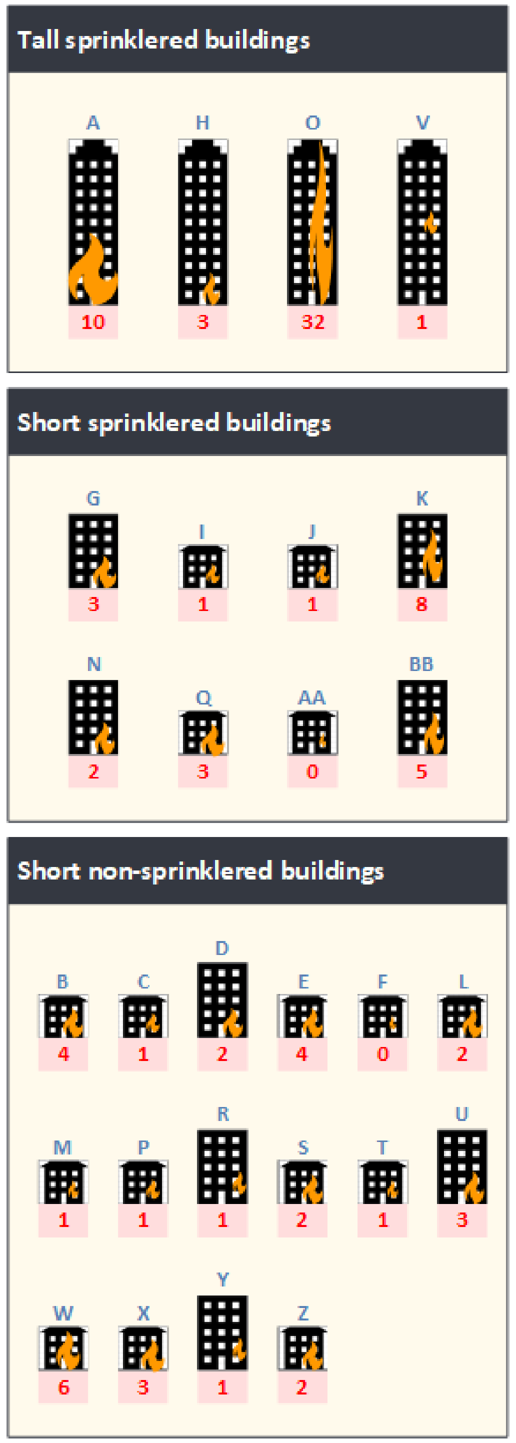
2 iF-SCAN assessment

- Estimate of the no. of SOUs a façade fire may spread to via cladding if started in worst location
- Desktop based review
- Uses visual images, plans and available documents



3 Separate Into 'building type' groups

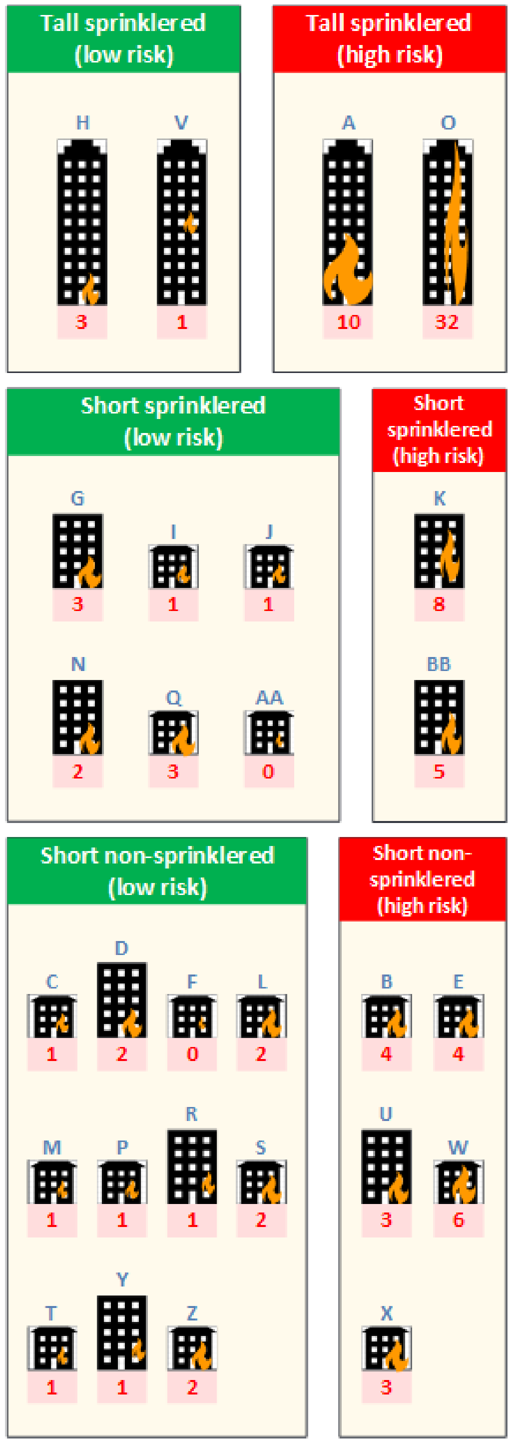
- 1st separate on building height (>25m?)
- 2nd separate on sprinkler protection to SOUs
- Buildings only compared to buildings in same group in later stages where priority sequence determined



This step creates 3 groups

4 Separate each group into high and low risk

- Categorisation based on iF-SCAN
- SOU count >= threshold level = high risk
- Threshold for sprinklered buildings =4 and for non-sprinklered =3



This step creates 6 groups

5 Assign each building to a risk cohort

- Value of iF-SCAN does not influence sequencing further
- A cohort code is built to represent the risk profile of a building
- The 1st part of the code captures the earlier steps
- The 2nd part of the code is built using iAuditor and RAT data
- One or more buildings can share the same cohort code

A First part the code reflects sprinkler status, building height and cladding risk premium status

e.g. SPRK- TALL- UPR

- Indicates building is sprinklered (SPRK-)
- Indicates building is over 25m tall (TALL-)
- Indicates building has an iF-SCAN above the threshold (UPR)

B Second part the code reflects the binary coding of RAT / iAuditor data for 6 risk factors

	Exit risk	Type of cladding	Fire fighting	Speed of evac.	Egress prov.	No. of SOUs
High	1	1	1	1	1	1
Low	0	0	0	0	0	0

This creates a code like this: 010111

C Combine the two parts to create the cohort code

e.g. SPRK-TALL-UPR-010111

Every building has a code like this

6 Create a priority sequence for the risk cohorts

- The sorting process is carried out separately for each of the 6 groups (i.e. all buildings in a sorting process have the same start to their codes (e.g. SPRK-TALL-UPR).
- An expert group ranks the cohorts based on the risk represented by the 6 risk factors (captured by the code 010111)

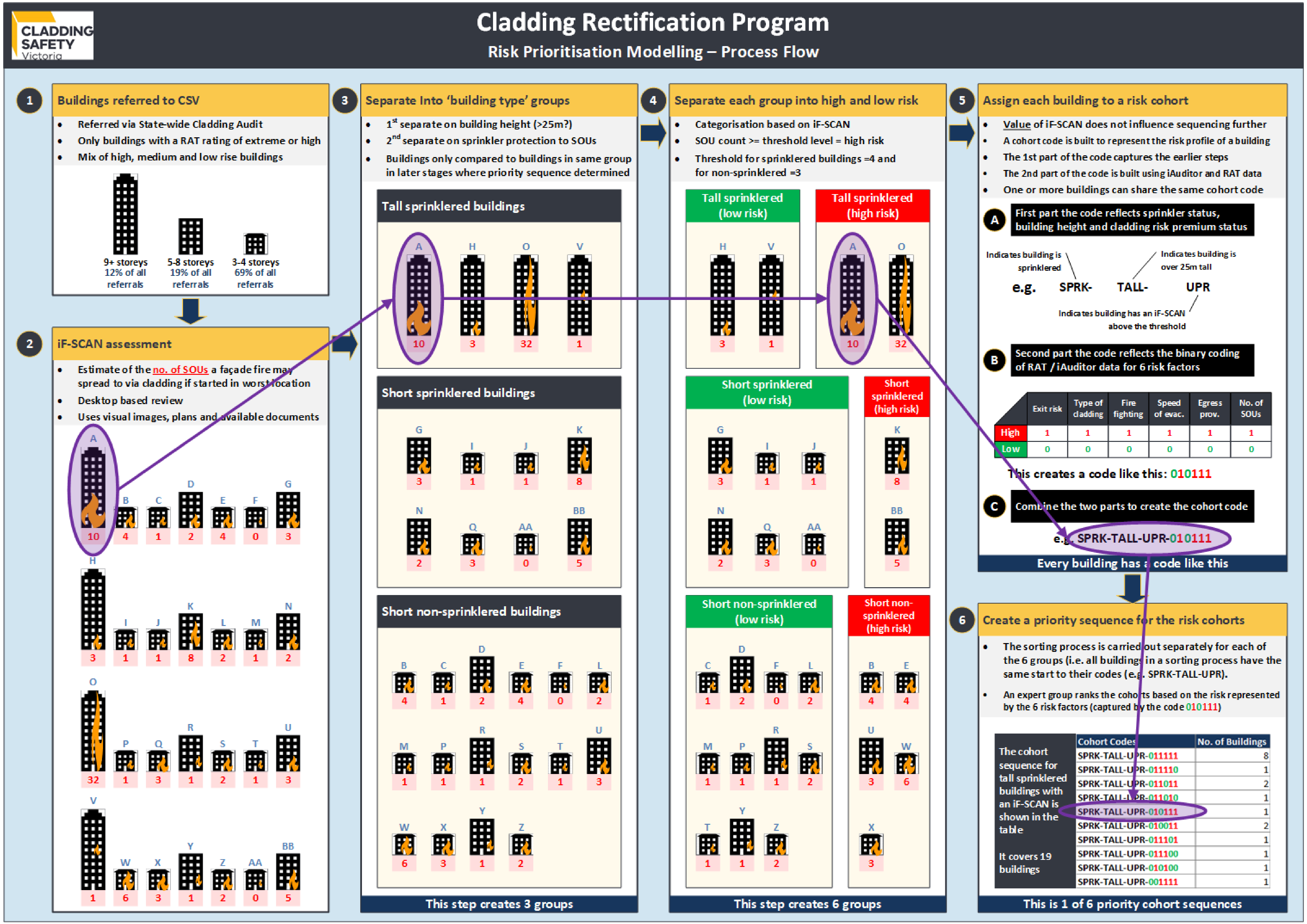
The cohort sequence for tall sprinklered buildings with an iF-SCAN is shown in the table

It covers 19 buildings

Cohort Codes	No. of Buildings
SPRK-TALL-UPR-011111	8
SPRK-TALL-UPR-011110	1
SPRK-TALL-UPR-011011	2
SPRK-TALL-UPR-011010	1
SPRK-TALL-UPR-010111	1
SPRK-TALL-UPR-010011	2
SPRK-TALL-UPR-011101	1
SPRK-TALL-UPR-011100	1
SPRK-TALL-UPR-010100	1
SPRK-TALL-UPR-001111	1

This is 1 of 6 priority cohort sequences

The diagram below illustrates how a single building moves through the sorting and sequencing steps.



Appendix D: Risk Assessment Tool variables

The Risk Assessment Tool (**RAT**) consists of 18 risk variables (or criteria), broken into three groups of measures:

- Overall risk factors (criteria 1 - 4);
- Risk of fire spread (criteria 5 - 12); and
- Ability to exit (criteria 13 - 18).

	Risk Criteria	Description	Criteria Values
Overall risk factors			
1	**Building/occupancy type**	This assessment should be based on the predominant class of the building under the Building Code, except where occupants are primarily vulnerable persons who will need assistance to evacuate e.g. hospital patients, children, elderly, disabled, residents in detention.	▪ Class 9a or 9c building or a building where occupants otherwise need assistance in evacuation ▪ Class 2, 3, 9b building ▪ Class 4, 5, 6, 7, 8 buildings
2	**Number of occupants / sole occupancy units**	This assessment is based on the number of sole occupancy units for residential buildings, or the maximum occupancy according to the occupancy permit for other types of buildings.	▪ 1-10 units ▪ 11-50 units ▪ 51-150 units ▪ 151+ units ▪ 1-30 occupants ▪ 31-150 occupants ▪ 151-450 occupants ▪ 451+ occupants
3	**Types of combustible cladding present**	Some types of ACP present a lower risk of fire spread and this is reflected with a lower fire spread risk score. Only aluminium composite panels (ACP) and expanded polystyrene will impact on the scoring on this criteria. The highest risk type of combustible cladding present should be selected.	▪ Expanded polystyrene ▪ ACP PE ▪ ACP unclear ▪ ≤30% PE content ACP ▪ ≤10% PE content ACP
4	**Automatic suppression (sprinklers)**	Sprinklers reduce the spread of fire and increase the ability of occupants to exit. Current advice suggests that wall drenchers are ineffective in controlling cladding fires, so do not result in a score reduction	▪ No sprinklers ▪ Basement carpark only ▪ Protecting exit paths only ▪ Fully sprinkled excluding balconies and canopies ▪ Fully sprinkled including SOU's, balconies and canopies
Risk of fire spread			
5	**Extent of combustible cladding**	Extent of combustible cladding on the external walls of the whole building, excluding windows. All combustible cladding, including timber and other composite products should be included in the calculation of the extent.	▪ 50-100% coverage ▪ 25-50% coverage ▪ 0-25% coverage or decorative element only
6	**Configuration of combustible cladding**	Generally, the risk of fire spread increases if the combustible cladding extends unbroken between SOUs. Cladding can be separated by spandrels, aprons, balconies or non-flammable building products. Risk of fire spread is generally higher if the cladding runs vertically than horizontally.	▪ Unbroken vertical cladding ▪ Unbroken horizontal cladding ▪ Broken vertical cladding ▪ Broken horizontal cladding
7	**Proximity of combustible cladding to potential ignition sources**	An overall score for the level of risk presented by the combustible cladding being in close proximity to potential ignition sources, particularly ground level, balconies and electrical penetrations.	▪ Extreme ▪ High ▪ Moderate ▪ Low

	Risk Criteria	Description	Criteria Values
8	**Fire rating of external walls (behind cladding)**	Where the wall system behind the combustible cladding does not achieve the required fire rating level (FRL) this can increase the risk of fire spread. This will often be unclear from the visual inspection, in which case it should be categorised as unclear until the FRL can be confirmed using documentary or other evidence. Caution should be exercised in relying on building permit plans for this information.	▪ Unclear ▪ No ▪ Yes
9	**Risk of combustible cladding fire to or from adjacent buildings**	Distance from the combustible cladding to the closest fire source feature, defined in the NCC as:- a building (other than a Class 10 building) on the same allotment- the far side of the road- the side or rear boundary of an allotment.	▪ < 3m distance ▪ > 3m distance ▪ > 6m distance ▪ > 10m distance
10	**Windows, doors, or other openings adjacent to combustible cladding**	Windows, doors, or other openings in-plane, adjacent or within close proximity (0.5 metres horizontal or 1 metre vertical) of combustible cladding.	▪ Yes ▪ No
11	**Insulation type behind combustible cladding**	Combustible insulation can increase the risk of fire spread. This is very unlikely to be able to be determined from a visual inspection, in which case it should be categorised as unclear until the insulation material can be confirmed using documentary or other evidence. Caution should be exercised in relying on building permit plans for this information. Where there is no additional insulation behind EPS or ACP cladding, this should be recorded as no additional insulation.	▪ No additional insulation ▪ Mineral fibre ▪ Rock wool ▪ Glass wool ▪ Sheep wool ▪ Plastics (EPS, Polyester, Phenolic) ▪ Unclear
12	**Fixing method**	The type of fixing used for ACP can increase the risk of fire spread. For example, tape fixed ACP is more likely to have an exposed core than mechanically fixed ACP.EPS is always considered mechanically fixed.	▪ Mechanical ▪ Other or Unclear

	Risk Criteria	Description	Criteria Values
Ability to exit			
13	**Egress provisions**	An overall score for the adequacy of egress provisions in the building. These scores should be based on an informed opinion of the overall adequacy of the building's egress provisions to enable occupants to evacuate safely. This assessment should take into account the building type and use, the number and location of exits, the number and location of stairs, the adequacy of fire isolation systems and the presence of any cladding around exits.	▪ Very Good ▪ Good ▪ Fair ▪ Poor
14	**Speed of Evacuation**	An overall score for the speed of evacuation being the time occupants take to leave the building or to enter a safe refuge such as a fire isolated stair without being subject to untenable conditions once a fire has commenced. Key considerations should be:- smoke and fire detection - occupant warning systems- monitored systems- the number of storeys above ground) - the number of SOUs/occupants- whether occupants are ambulant or need assistance- the length of corridors	▪ Very Good ▪ Good ▪ Fair ▪ Poor
15	**Fire fighting provisions**	An overall score for the adequacy of fire fighting provisions. These scores should be based on an informed opinion of the overall adequacy of the building's fire fighting provisions Key factors may include:- the location of the nearest hydrant and whether it has a booster or pump- whether the fire indicator panel is in close proximity to combustible cladding- whether a fire control centre is required and its access is hindered by combustible cladding- the distance of the hardstand from the building and its accessibility for a fire truck.- the accessibility of each face of the building for fire fighting purposes.- the presence of any encumbrances such as over-head power or tram wires.	▪ Very Good ▪ Good ▪ Fair ▪ Poor
16	**Active systems connected to a monitoring agency.**	Monitored systems can reduce fire brigade response time, improving their ability to control the fire and assist with the evacuation of residents.	▪ Yes ▪ No/unclear

	Risk Criteria	Description	Criteria Values
17	**Essential safety measure maintenance**	The maintenance of essential safety measures, such as sprinkler systems, is important in ensuring that they will perform as designed in the event of a fire. These scores should be based on an informed professional opinion of the overall adequacy of the building's essential safety measure maintenance. Key considerations include the condition of essential safety equipment and the building's compliance with its essential safety measure maintenance and reporting obligations.	▪ Very Good ▪ Good ▪ Fair ▪ Poor
18	**Building management, 24/7 onsite security or warden system**	An onsite presence (such as building management, security or a warden) can aid safe exit, including where buildings may be used for serviced apartments or temporary accommodation, such as AirBnB.	▪ Not clear ▪ No ▪ Part time ▪ Yes

Distribution of ratings by RAT criteria

A review of RAT data was undertaken for 647 buildings for which RAT data was available to CSV. The distribution of ratings across standard criteria values is presented below.

Variable 1: Building/occupancy Type - Risk Assessment Tool Distribution of Raw Scores

Variable Code	Variable value	No. of buildings	% share
1	Class 4, 5, 6, 7, 8 buildings	0	0%
1.2	Class 2, 3, 9b building	647	100%
1.5	Class 9a or 9c building or a building where occupants otherwise need assistance in evacuation	0	0%
Total		**647**	

Source: Cladding Safety Victoria, RAT distribution analysis, 23 April 2021

Notes

1. This table presents the data captured in Risk Assessment Tool (RAT) assessments for 647 of the 684 buildings referred to Cladding Safety Victoria between July 2019 and 6 April 2021.

Variable 2: Number of occupants - Risk Assessment Tool Distribution of Raw Scores

Variable Code	Variable value	No. of buildings	% share
1	1-10 units or 1-30 occupants	133	21%
1.1	11-50 units or 31-150 occupants	360	56%
1.2	51-150 units or 151-450 occupants	94	15%
1.3	151+ units or 451+ occupants	60	9%
Total		**647**	

Source: Cladding Safety Victoria, RAT distribution analysis, 23 April 2021

Notes

1. This table presents the data captured in Risk Assessment Tool (RAT) assessments for 647 of the 684 buildings referred to Cladding Safety Victoria between July 2019 and 6 April 2021.

Variable 3: Types of cladding present - Risk Assessment Tool Distribution of Raw Scores

Variable Code	Variable value	No. of buildings	% share
0.25	≤10% PE content ACP	0	0%
0.5	≤30% PE content ACP	17	3%
1	Expanded polystyrene, ACP PE or ACP unclear	630	97%
Total		**647**	

Source: Cladding Safety Victoria, RAT distribution analysis, 23 April 2021

Notes

1. This table presents the data captured in Risk Assessment Tool (RAT) assessments for 647 of the 684 buildings referred to Cladding Safety Victoria between July 2019 and 6 April 2021.

Variable 4: Automatic suppression (sprinklers) - Risk Assessment Tool Distribution of Raw Scores

Variable Code	Variable value	No. of buildings	% share
0.75	Fully sprinkled including SOU's, balconies and canopies	18	3%
0.85	Fully sprinkled excluding balconies and canopies	238	37%
0.95	Basement carpark only OR Protecting exit paths only	89	14%
1	No sprinklers	302	47%
Total		**647**	

Source: Cladding Safety Victoria, RAT distribution analysis, 23 April 2021

Notes

1. This table presents the data captured in Risk Assessment Tool (RAT) assessments for 647 of the 684 buildings referred to Cladding Safety Victoria between July 2019 and 6 April 2021.

Variable 5: Extent of combustible cladding - Risk Assessment Tool Distribution of Raw Scores

Variable Code	Variable value	No. of buildings	% share
1	0-25% coverage or decorative element only	336	52%
2	25-50% coverage	161	25%
3	50-100% coverage	150	23%
Total		**647**	

Source: Cladding Safety Victoria, RAT distribution analysis, 23 April 2021

Notes

1. This table presents the data captured in Risk Assessment Tool (RAT) assessments for 647 of the 684 buildings referred to Cladding Safety Victoria between July 2019 and 6 April 2021.

Variable 6: Configuration of cladding - Risk Assessment Tool Distribution of Raw Scores

Variable Code	Variable value	No. of buildings	% share
0	Broken horizontal cladding	23	4%
1	Broken vertical cladding	24	4%
2	Unbroken horizontal cladding	117	18%
3	Unbroken vertical cladding	483	75%
Total		**647**	

Source: Cladding Safety Victoria, RAT distribution analysis, 23 April 2021

Notes

1. This table presents the data captured in Risk Assessment Tool (RAT) assessments for 647 of the 684 buildings referred to Cladding Safety Victoria between July 2019 and 6 April 2021.

Variable 7: Proximity of cladding to potential ignition sources - RAT Distribution of Raw Scores

Variable Code	Variable value	No. of buildings	% share
0	Low	5	1%
1	Moderate	61	9%
2	High	319	49%
3	Extreme	262	40%
Total		**647**	

Source: Cladding Safety Victoria, RAT distribution analysis, 23 April 2021

Notes

1. This table presents the data captured in Risk Assessment Tool (RAT) assessments for 647 of the 684 buildings referred to Cladding Safety Victoria between July 2019 and 6 April 2021.

Variable 8: Fire rating of external walls (behind cladding) - RAT Distribution of Raw Scores

Variable Code	Variable value	No. of buildings	% share
0	Yes	90	14%
3	No OR Unclear	557	86%
Total		**647**	

Source: Cladding Safety Victoria, RAT distribution analysis, 23 April 2021

Notes

1. This table presents the data captured in Risk Assessment Tool (RAT) assessments for 647 of the 684 buildings referred to Cladding Safety Victoria between July 2019 and 6 April 2021.

Variable 9: Risk of cladding fire to or from adjacent buildings - RAT Distribution of Raw Scores

Variable Code	Variable value	No. of buildings	% share
0	> 10m Separation	43	7%
1	> 6m Separation	82	13%
2	> 3m Separation	228	35%
3	< 3m Separation	294	45%
Total		**647**	

Source: Cladding Safety Victoria, RAT distribution analysis, 23 April 2021

Notes

1. This table presents the data captured in Risk Assessment Tool (RAT) assessments for 647 of the 684 buildings referred to Cladding Safety Victoria between July 2019 and 6 April 2021.

Variable 10: Windows, doors, or other openings adjacent to cladding - RAT Distribution of Raw Scores

Variable Code	Variable value	No. of buildings	% share
0	No	9	1%
3	Yes	638	99%
Total		**647**	

Source: Cladding Safety Victoria, RAT distribution analysis, 23 April 2021

Notes

1. This table presents the data captured in Risk Assessment Tool (RAT) assessments for 647 of the 684 buildings referred to Cladding Safety Victoria between July 2019 and 6 April 2021.

Variable 11: Insulation type behind cladding - Risk Assessment Tool Distribution of Raw Scores

Variable Code	Variable value	No. of buildings	% share
0	No additional insulation, Mineral fibre OR Rock wool	74	11%
1	Glass wool	22	3%
3	Sheep wool, Plastics (EPS, Polyester, Phenolic) OR Unclear	551	85%
Total		**647**	

Source: Cladding Safety Victoria, RAT distribution analysis, 23 April 2021

Notes

1. This table presents the data captured in Risk Assessment Tool (RAT) assessments for 647 of the 684 buildings referred to Cladding Safety Victoria between July 2019 and 6 April 2021.

Variable 12: Fixing method - Risk Assessment Tool Distribution of Raw Scores

Variable Code	Variable value	No. of buildings	% share
0	Mechanical	322	50%
3	Other or unclear	325	50%
Total		**647**	

Source: Cladding Safety Victoria, RAT distribution analysis, 23 April 2021

Notes

1. This table presents the data captured in Risk Assessment Tool (RAT) assessments for 647 of the 684 buildings referred to Cladding Safety Victoria between July 2019 and 6 April 2021.

Variable 13: Egress provisions - Risk Assessment Tool Distribution of Raw Scores

Variable Code	Variable value	No. of buildings	% share
0	Very Good	6	1%
1	Good	194	30%
2	Fair	343	53%
3	Poor	104	16%
Total		**647**	

Source: Cladding Safety Victoria, RAT distribution analysis, 23 April 2021

Notes

1. This table presents the data captured in Risk Assessment Tool (RAT) assessments for 647 of the 684 buildings referred to Cladding Safety Victoria between July 2019 and 6 April 2021.

Variable 14: Speed of Evacuation - Risk Assessment Tool Distribution of Raw Scores

Variable Code	Variable value	No. of buildings	% share
0	Very Good	11	2%
1	Good	341	53%
2	Fair	259	40%
3	Poor	36	6%
Total		**647**	

Source: Cladding Safety Victoria, RAT distribution analysis, 23 April 2021

Notes

1. This table presents the data captured in Risk Assessment Tool (RAT) assessments for 647 of the 684 buildings referred to Cladding Safety Victoria between July 2019 and 6 April 2021.

Variable 15: Fire fighting provisions - Risk Assessment Tool Distribution of Raw Scores

Variable Code	Variable value	No. of buildings	% share
0	Very Good	2	0%
1	Good	128	20%
2	Fair	373	58%
3	Poor	144	22%
Total		**647**	

Source: Cladding Safety Victoria, RAT distribution analysis, 23 April 2021

Notes

1. This table presents the data captured in Risk Assessment Tool (RAT) assessments for 647 of the 684 buildings referred to Cladding Safety Victoria between July 2019 and 6 April 2021.

Variable 16: Active systems connected to a monitoring agency. - RAT Distribution of Raw Scores

Variable Code	Variable value	No. of buildings	% share
0	Yes	395	61%
3	No OR Unclear	252	39%
Total		**647**	

Source: Cladding Safety Victoria, RAT distribution analysis, 23 April 2021

Notes

1. This table presents the data captured in Risk Assessment Tool (RAT) assessments for 647 of the 684 buildings referred to Cladding Safety Victoria between July 2019 and 6 April 2021.

Variable 17: Essential safety measure maintenance - Risk Assessment Tool Distribution of Raw Scores

Variable Code	Variable value	No. of buildings	% share
0	Very Good	9	1%
1	Good	244	38%
2	Fair	287	44%
3	Poor	107	17%
Total		**647**	

Source: Cladding Safety Victoria, RAT distribution analysis, 23 April 2021

Notes

1. This table presents the data captured in Risk Assessment Tool (RAT) assessments for 647 of the 684 buildings referred to Cladding Safety Victoria between July 2019 and 6 April 2021.

Variable 18: Building management, 24/7 onsite security or warden system - RAT Distribution of Raw Scores

Variable Code	Variable value	No. of buildings	% share
0	Yes	31	5%
2	Part time	33	5%
3	No OR Not clear	583	90%
Total		**647**	

Source: Cladding Safety Victoria, RAT distribution analysis, 23 April 2021

Notes

1. This table presents the data captured in Risk Assessment Tool (RAT) assessments for 647 of the 684 buildings referred to Cladding Safety Victoria between July 2019 and 6 April 2021.