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Escape route pressurisation systems: A pilot study of New Zealand data

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Preface

This study report describes research conducted as part of a pilot study to investigate escape route pressurisation system effectiveness in New Zealand buildings.

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Abstract

While escape route pressurisation systems have been used for some time in New Zealand buildings as part of the fire safety strategy, there is little data and many questions about how effective they are. This report describes a pilot study that investigated escape route pressurisation system effectiveness in New Zealand buildings. Fire and Emergency New Zealand (FENZ) data and council data was used to look at fire incidents in private fire alarm (PFA) connected buildings with and without pressurisation systems in Auckland, Wellington and Christchurch. The effect of pressurisation systems on life safety outcomes was found to be inconclusive, but there was a measurable decrease in reported flame and smoke spread beyond the compartment of fire origin. Individual system data from property files, a site visit and independent qualified person (IQP) interviews was also gathered. This data indicated similar operational issues with current New Zealand systems as has been reported previously in New Zealand and other jurisdictions. Improving design, installation and commissioning practices is highly recommended to improve confidence in potential escape path pressurisation system benefits in building fire safety strategies.

Keywords

Escape route pressurisation systems, fire incident data, inspection, testing and maintenance.

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Executive summary

A pilot study into escape path pressurisation system effectiveness in New Zealand buildings was undertaken. Two approaches were used. The first was to look at fire incident data and council data for Auckland, Wellington and Christchurch buildings with a private fire alarm (PFA) connection. The second looked at individual system data using property files, a site visit and interviews with independent qualified persons (IQPs).

Key findings from the fire incident data were as follows:

- There are approximately 400 buildings in the three cities with escape route pressurisation systems listed on their compliance schedule.
- Of these 400 buildings, 325 or 80% had PFA connections – this equated to approximately 4% of all PFA-connected buildings.
- Pressurisation system effects on life safety outcomes were inconclusive.
- Flame and smoke damage reports beyond the compartment of fire origin were measurably lower in buildings with escape route pressurisation systems.

Key findings from the individual system approach were as follows:

- Property file documentation on installation, commissioning, design, maintenance, inspection and testing is often sparse.
- Instances where building warrants of fitness (BWoFs) were not issued due to a lack of evidence of maintenance, inspection and/or testing were found.
- Despite the small sample size, many system operational problems were found.

Overall, it appears that escape route pressurisation systems may provide some limited benefit in confining flame and smoke damage to the compartment of fire origin. However, confidence in individual systems remains low due to the weak systems in place to assure proper system operation. It is possible to extend this study to capture all buildings in New Zealand using the fire incident data approach and to expand the investigation into individual system information. It is unlikely that different conclusions will be drawn from this approach, and a more useful application of resources would be to develop more robust controls and practices for design, installation and ongoing functioning of escape route pressurisation systems in New Zealand buildings.

1. Introduction

Escape route pressurisation systems are a type of safety system that have been used in New Zealand buildings to help demonstrate compliance with the fire safety building regulation requirements. They are intended to protect key areas of the building from smoke ingress during a fire event. These key areas are typically compartments intended to keep many occupants safe while evacuating the building or to improve conditions for fire and rescue operations or both. Common examples are stairwells or corridors. While the concept is relatively simple, there are many opinions as to how effective these systems are in contributing to fire safety within buildings. There is little direct evidence of how well escape route pressurisation systems actually work under fire conditions.

The Acceptable Solution C/AS1 included escape route pressurisation as a requirement for some building configurations up until 2012. In 2012, the Acceptable Solutions were split by building occupancy type, and the intent was shifted to simpler building configurations. Reference to pressurisation systems was removed from the Acceptable Solutions from 2012 onwards because they were considered to be a complex feature and no longer within the scope of the Acceptable Solutions (MBIE, 2013). The current Verification Method (VM) also does not discuss pressurisation specifically. The pressurisation system design standard that has been referenced in New Zealand building regulation documents is AS/NZS 1668.1:1998 (Standards Australia/Standards New Zealand, 1998). A revised version was released in 2015. Other design standards may have been used in New Zealand buildings, but specific instances have not been identified in this research. However, evidence indicates that pressurisation systems are still being specified in New Zealand buildings despite not being explicitly included in fire safety regulatory requirements.

This research is a pilot study to investigate what can be learned about pressurisation system usage and effectiveness in New Zealand buildings from council property file and Fire and Emergency New Zealand (FENZ) fire incident data. Buildings containing pressurisation systems were identified using compliance schedule databases, which list escape route pressurisation systems as a specified system if one is specified at consent. Auckland, Wellington and Christchurch data was considered in this study. As the major metropolitan New Zealand municipalities, it is expected that they would contain the most buildings with pressurisation systems. Future work could expand this study to encompass all of New Zealand.

1.1 Theory of operation

The theory behind pressurisation systems is straightforward. In a fire, the buoyant nature of the combustion products causes smoke to flow through the building. Pressurisation systems can work by either extracting gases from the fire compartment to reduce the pressure below that of adjacent compartments (negative pressurisation) or forcing fresh air into a protected compartment to increase the pressure above the pressure that a fire could be expected to generate in an adjacent compartment (positive pressurisation).

Pressurisation systems require coordination between the building's normal heating, ventilation and air conditioning (HVAC) operation and fire-mode operation. Most systems will require some sort of purge mechanism, providing pathways for smoke to leave the building. This can be either powered (via smoke exhaust fans) or using the

natural smoke buoyancy. There will often also be parts of the normal HVAC system, not used for the smoke control system, that will require shutdown to prevent smoke movement through the building.

A more complex system type is called a "zone" or "sandwich" pressurisation system. These systems attempt to isolate fire gases to the compartment where the fire originated rather than keeping individual key compartments clear. This approach typically provides positive pressure to compartments surrounding the fire compartment and ambient or negative pressure in the fire compartment while exhausting the fire compartment to the outside.

1.1.1 Equipment associated with pressurisation systems

Mechanical fans are typically used to provide the driving force for pressurisation systems. These fans may be dedicated to the pressurisation system or part of the general building HVAC systems. A trigger that a fire has occurred is required to start the fan, which usually is a fire alarm system signal from a smoke or heat detector. The compartment boundaries (walls, ceilings and floors including doors and other openings) are also an integral part of the system. Depending on the direction that the doors open into or out of the compartment, the pressurisation system will either make them more difficult to open or tend to force them open, respectively. Additional air transport equipment including ducts, grilles, diffusers and dampers are usually also part of the system. A fire fan control panel (FFCP) is required by AS/NZS 1668.1 to allow automatic control and manual override of fans and dampers as required and also to indicate the operational status of fans and dampers.

Pressurisation systems may be as simple as a single fan connected to the alarm system, or they could involve the interfacing of hundreds of components, with each fire location requiring the components to react in a differently coordinated manner. As a general trend, increasing complexity is expected to have an adverse effect on system reliability unless specific measures are undertaken to compensate (Klote & Milke, 1992). These measures can include:

- more extensive commissioning
- greater inspection and testing requirements
- system redundancy.

While system redundancy provides back-up measures for system operation, it also increases system complexity, which can reduce the expected benefits. Another consideration is that pressurisation systems are active and use the electrical supply as the main energy source. The AS/NZS 1668.1:1998 and AS/NZS 1668.1:2015 standards require connection to the essential electrical supply, but this may not include emergency back-up. A failure in the power supply will cause the system to fail. Consequently, back-up sources of electricity such as generators as well as appropriate maintenance schedules associated with them will be critical to achieve intended outcomes. Wiring and electrical equipment are required to continue to function under fire conditions. AS/NZS 1668.1 requires wiring systems to have a protection against fire exposure rating of not less than 120 minutes, when classified using AS/NZS 3013:2005 *Electrical installations – Classification of the fire and mechanical performance of wiring system elements*. There are also requirements for protection against mechanical and water damage.

1.1.2 Confounding factors in pressurisation system operation

While pressurisation systems are based on simple theory and operating criteria, there are several factors that make effective implementation practically difficult. Mechanically operated systems do not operate instantaneously, forces are involved in their operation and the system response can lag the system input variable changes. For example, damper positions may need to be changed for proper pressurisation effectiveness, but the actuators may not be capable of handling the flows or differential pressures associated with the pressurisation system. They may need to be placed in the proper orientation before ramping up the fan to achieve the needed flows and pressures. They also take a finite length of time to move.

Changes in flow paths – for example, doors moving from closed to open or vice versa – change the system pressure-flow curve, which the pressurisation system needs to adjust to maintain the required pressure difference or flow conditions. Tighter (less leaky) compartments are affected more by these changes than leaky compartments. However, if the compartment is leakier than the design intended, the fans may not be able to provide the required performance. Adequate relief air paths are required as well so that the pressure in the fire compartment does not equalise with the pressurised compartment.

Temperature differences between the pressurised compartment and the outside also can create the stack effect, which changes the pressure differentials across the compartment boundaries. The stack effect results from density gradient differences between adjacent vertical columns of air due to temperature differences. A chimney is an example, where hot buoyant gases tend to rise, reducing the pressure at the bottom and increasing the pressure at the top when compared to cold air outside the chimney.

The stack effect becomes more pronounced for taller vertical compartments and larger temperature differences. Using untreated outside air (close to the outside ambient temperature) in the pressurised compartment minimises the stack effect, although some effect is still likely due to heat transfer from temperature-controlled compartments in the building. New Zealand conditions (shorter buildings, moderate outdoor temperatures and relatively poor indoor thermal control) tend to produce less stack effect than would be found in other international jurisdictions.

1.1.3 Pressurisation system operating criteria

Ideal gas theory predicts that fires can cause positive pressure differences of up to approximately 15 Pa at typical post-flashover temperatures of 1000°C and ordinary ceiling heights of 2.7 m. Taller compartments can generate higher pressures. Pressurisation systems are usually designed to produce a minimum pressure difference that exceeds the maximum expected fire pressure. Alternatively, and particularly for cases where large openings are expected, a minimum opening velocity is specified. Usually there is a maximum allowable pressure difference, which is limited by the force required to open doors into the compartment.

For AS/NZS 1668.1:1998, the operating criteria depend on the type of pressurisation system: either fire-isolated exit or lift shaft. Fire-isolated exit pressurisation systems have minimum airflow and maximum door opening force requirements. The airflow requirements are that an airflow velocity of not less than 1 m/s averaged over the full door area must be maintained while the main discharge (egress) doors and all doors to the fire-affected compartment are open. The airflow must also be directed from the

pressurised compartment to the fire-affected compartment across the top two-thirds of the doorway unless it can be proven that flow in the other direction will not adversely affect safety in the pressurised exit compartment. The 1 m/s criterion is reported in AS/NZS 1668.1:1998 as being based on CSIRO fire research that suggested 0.8 m/s was sufficient to prevent smoke from migrating through a door with a transom depth of approximately 500 mm.

There are further requirements depending on whether the system includes zone, purge or system shutdown features:

- For a zone system, this airflow must be maintained while only these doors are open.
- For purge or system shutdown variants, this airflow must be maintained while all doors immediately above or adjacent to the fire-affected compartment are also fully open.

Additionally, the criteria above must be restored with minimal delay not exceeding 10 seconds if affected by any factors such as door operation. They must also be maintained despite the effects of other smoke control or pressurisation systems operating at the same time. There is also a noise level requirement with a maximum sound pressure level in occupied spaces of 80 dBA.

Maximum door forces are also measured under different conditions depending on whether the system is a purge or system shutdown system or a zone system. The door opening force and latching requirements must be met when all doors to the fire-isolated exit are closed for a purge or system shutdown system. For zone systems, the maximum door opening force must not be exceeded whether the doors immediately above or adjacent are open or closed.

Lift shaft pressurisation systems require a pressure difference of 20–50 Pa between the lift shaft and the occupied space of the building. Higher pressure differences may result in difficulties with lift door operation but are allowable on a specific design basis if lift door operation can be assured.

1.2 BWoF and compliance schedule requirements

Section 100 of the New Zealand Building Act 2004 requires compliance schedules for buildings that include specified systems, including escape route pressurisation systems. A building's compliance schedule includes requirements for the inspection and maintenance of the specified systems in the building. Section 108 of the Act requires that all owners of buildings with a compliance schedule supply the territorial authority with an annual BWoF stating that "the inspection, maintenance, and reporting procedures of the compliance schedule have been fully complied with during the previous 12 months". The Compliance Schedule Handbook provides guidelines on developing compliance schedules (MBIE, 2014).

For escape route pressurisation systems, the Compliance Schedule Handbook recommends using either AS 1851 or a specifically designed solution prepared by a competent person for inspection content and frequency. Preventative and responsive maintenance is to be "carried out in accordance with the nominated performance and inspection Standard or document, and to ensure the system will operate as required in the event of a fire".

1.2.1 AS 1851 requirements

Section 13 of AS 1851-2012 covers "routine service of fire and smoke control features of mechanical services in buildings covered by AS/NZS 1668.1" (Standards Australia, 2012). The principle behind the standard is made clear in the foreword "that a system will continue to perform to the approved design when routine service is conducted on a pre-determined and regular basis". The structure of AS 1851 changed substantially from the 2005 version (Standards Australia, 2005) to the 2012 version, the most recent at the time this research was conducted. This is reflected in the name change from *Maintenance of fire protection systems and equipment* to *Routine service of fire protection systems and equipment*. The 2012 version changes included more clearly delineating between installation and commissioning, routine servicing and regulatory compliance requirements. AS 1851-2012 is clear that adequate baseline data is required to be provided from installation and commissioning in order to establish the level of performance at the outset of a system's life. Inspection, testing and maintenance are then performed to prevent system performance from degrading below this benchmark.

Both AS 1851-2005 and AS 1851-2012 discuss their role in respect to AS 4655 and fire safety audits. AS 1851-2005 notes that the "audit process is a broader function" and is more generally intended to evaluate if fire safety systems "satisfy appropriate benchmarks, such as Standards, legislation, contractual arrangements, regulation and insurance requirements." AS 1851-2012 merely states that the AS 1851 survey requirements "do not require auditing to AS 4655 *Fire safety audits*".

AS 1851-2005 required the owner or occupier to keep extensive documentation of the system, including manuals, functionality and performance requirements, maintenance schedules and records, and plant and installation information. If the "installation is incomplete or not in accordance with approval documentation", the building owner or agent is to be notified. This requirement was removed from the body of AS 1851-2012, but the list of documentation was kept in informative Appendix H (i.e. for information only, not as a requirement).

AS 1851-2005 included requirements for the skill level and experience of personnel carrying out inspection, test, preventative maintenance and survey tasks. There are three levels from non-technical (minimum of 1 year's experience), technician (minimum of 3 years' experience and a relevant trade qualification) and specialist (experience varying depending on qualification but a minimum of 5 years' experience when combined with a relevant recognised engineering degree). The experience is to be directly related to inspection and testing of fire and smoke control systems, although at the specialist level, the experience can also be design and installation of fire and smoke control systems. Demonstrated knowledge of fire and smoke control systems is also required, along with the relevant design standards and building code requirements included at the technician and specialist level. These requirements were subsequently removed in AS 1851-2012, with the foreword noting only that "effective maintenance programs depend on suitably competent personnel". AS 1851-2012 Appendix H does include two levels of skill sets informatively. Skill set (A) corresponds to the technician level of AS 1851-2005, and skill set (B) required a minimum of 5 years' relevant experience in conjunction with either an engineering degree, diploma or trade qualification.

Both versions of AS 1851 also include comprehensive checklists for individual component and system inspection and testing, including frequency and results. Under

AS 1851-2005, persons with the non-technical skill level can undertake the most basic inspection tasks. Otherwise, technician competencies or skill set (A) is specified for persons undertaking routine service or inspection activities (examples include cleaning, checking filters, lubrication and so on). Specialist competencies or skill set (B) are required for system testing and annual design and installation surveys.

1.2.2 Pre-2012 C/AS1 pressurisation system testing requirements

Prior to 2012, C/AS1 required safe path pressurisation systems for some building configurations (Department of Building and Housing, 2011). Systems were required to comply with AS/NZS 1668.1:1998 section 9, to be activated by the detection system and also to include manual control. Appendix B included pressurisation system testing requirements prior to occupancy and annually after occupancy. Pre-occupancy tests included three steps:

1. Individual function tests of all system components.
2. Activate the system by artificially triggering detectors in a manner that would cover all likely fire origin locations.
3. Subject the system to a hot smoke test using the most complex fire location determined from step 2. Factors to consider included smoke and fresh air movement, escape routes and so on.

Progress to steps 2 and 3 required successful completion of the prior step. Annual testing then involved activating detectors for critical scenarios determined from the pre-occupancy step 2 testing. Results were to be compared to pre-occupancy test results and any changes made as necessary to correct deviations.

For smaller fire cells with an occupant load of 100 or fewer and no more than two intermediate floors, testing was restricted to a smoke test to verify detector and automatic vent opening operation.

1.3 International standards and other guidance on escape route pressurisation system design

International standards that provide design information for pressurisation systems include NFPA 92-2018 *Standard for smoke control systems* (NFPA, 2018) and EN 12101-6:2005 *Smoke and heat control systems – Part 6: Specification for pressure differential systems – Kits* (CEN, 2005). NFPA 92 requires a minimum pressure difference for stairwell pressurisation systems, as opposed to the velocity required in AS 1668.1. NFPA 92 is specific in requiring any openings and leakage areas to be considered in design of smoke control systems, including pressurisation systems. Guidance is also provided on testing leakage between smoke zones. EN 12101-6 provides six classifications of systems depending on the system objectives. Key differences between the classifications are shown in

Table 1. Classes B and F require 2 m/s airflow to deal with the scenario of an open door to a fully developed fire during firefighting operations. While it is noted that gas velocities could reach 5 m/s from a fully developed fire, it is expected that the firefighting operations themselves will assist in holding back smoke from the egress route. In general, a pressure difference of 50 Pa is required when all doors to the egress route are closed and the air release path is open. Classes B through F include additional pressure difference scenarios.

Table 1. EN 12101-6 pressurisation system classifications.

Class	Examples of use	Opening velocity	Pressure difference criterion scenarios
A	Means of escape – defend in place	0.75 m/s	Defend in place – 50 Pa when egress route doors are closed
B	Means of escape and firefighting	2 m/s	Class A plus 45 Pa between lobby and accommodation area
C	Means of escape – simultaneous evacuation	0.75 m/s	Class A plus 10 Pa when all doors except final exit door are closed
D	Means of escape – sleeping risk	0.75 m/s	Class A plus 10 Pa when the following are open: a door on a non-fire floor, the final exit door and all doors between the pressurised stair and the final exit door
E	Means of escape – phased evacuation	0.75 m/s	Class A plus 10 Pa when the following doors are open: doors on two adjacent floors, the final exit door and all doors between the pressurised stair and the final exit door
F	Firefighting system and means of escape	2 m/s 1 m/s*	Class A plus 45 Pa between each lobby and accommodation area

* Between the lobby and affected fire compartment

Other guidance on pressurisation system design is available in the *Handbook of Smoke Control Engineering* (Klote, Milke, Turnbull, Kashef & Ferreira, 2012) and the *SFPE Handbook of Fire Protection Engineering* (Klote, 2016), which includes a chapter on pressurisation system design. These sources include methodology and guidance for factoring in aspects like building leakage, the stack effect, friction losses in shafts and wind and choosing single or multiple injection system design. They also discuss modelling pressurisation systems with the freely available network computer model CONTAM, developed by the National Institute of Standards and Technology (NIST) in the US. This software can be used to run design scenarios considering the complicating factors in escape route pressurisation system design. It is noted that analysis with a network computer model is necessary for complicated building geometry to determine if a pressurisation system design can operate as intended.

1.4 Measuring pressurisation system effectiveness

Effectiveness can be defined as the product of reliability (did the system operate when called upon?) and efficacy (did the system do what it was supposed to?) (Thomas, 2002). True measures of pressurisation system effectiveness would investigate the performance of pressurisation systems under real fire conditions. This is generally difficult if not impossible when compared to other active fire protection systems. Detection system effectiveness can be determined quite readily by investigating how occupants and/or first responders were notified that a fire was occurring. Suppression system efficacy can be slightly more difficult because the influence of the system operation on the fire outcome can be difficult to determine. Many fires will run out of fuel or oxygen and self-extinguish on their own. However, it is relatively easy to establish if the suppression system was present, operated or not, and if the suppressing agent was distributed as intended.

The objective of pressurisation systems is to prevent the movement of smoke, and to a lesser extent fire, from compartments affected by fire into those not affected. Often compartments that form part of the shared egress route or safe path are targeted for

protection by pressurisation systems as part of the life safety strategy for the building. In these instances, the pressurisation system would be contributing to meeting the following New Zealand Building Code (NZBC) clauses:

Societal objectives

- **C1(a)** safeguard people from an unacceptable risk of injury or illness caused by fire
- **C1(c)** facilitate firefighting and rescue operations

Functional requirements

- **C3.1** Buildings must be designed and constructed so there is a low probability of injury or illness to persons not in close proximity to a fire source.
- **C4.2** Buildings must be provided with means of escape to ensure that there is a low probability of occupants of those buildings being unreasonably delayed or impeded from moving to a place of safety and that those occupants will not suffer injury or illness as a result.
- **C5.1** Buildings must be designed and constructed so that there is a low probability of firefighters or other emergency services personnel being delayed in or impeded from assisting in rescue operations and performing firefighting operations.
- **C5.2** Buildings must be designed and constructed so that there is a low probability of illness or injury to firefighters or other emergency services personnel during rescue and firefighting operations.

Performance criteria

- **C3.9** Buildings must be designed and constructed with regard to the likelihood and consequence of failure of any fire safety system intended to control fire spread.
- **C4.3** The evacuation time must allow occupants of a building to move to a place of safety in the event of a fire so that occupants are not exposed to any of the following:
  (a) a fractional effective dose of carbon monoxide greater than 0.3
  (b) a fractional effective does of thermal effects greater than 0.3
  (c) conditions where, due to smoke obscuration, visibility is less than 10 m except in rooms of less than 100 m² where visibility may fall to 5 m.
- **C4.5** Means of escape to a place of safety in buildings must be designed and constructed with regard to the likelihood and consequences of failure of any fire safety systems.
- **C5.6** Buildings must be designed and constructed in a manner that will allow firefighters, taking into account the firefighters' personal protective equipment and standard training, to:
  (a) reach the floor of fire origin
  (b) search the general area of fire origin
  (c) protect their means of egress.
- **C5.8** Means to provide access for and safety of firefighters in buildings must be designed and constructed with regard to the likelihood and consequence of failure of any fire safety systems.

To summarise, escape route pressurisation systems can be used in a building fire safety strategy to satisfy the NZBC clauses that protect occupant and firefighter life safety and facilitate firefighting operations. They do this by protecting means of egress from smoke ingress that can affect tenability and visibility. The potential for any escape

route pressurisation systems in the building to fail when called upon must also be considered.

Determining if a pressurisation system operated as intended after a fire event can be difficult. It is not always evident that a pressurisation system is in fact present in a building because pressurisation systems are often made up of components used for other systems, most notably the fire detection system and building HVAC systems. Soot deposits and occupant/firefighter observations can be used to determine if smoke and/or fire moved into compartments intended to be protected. However, if no evidence of fire or smoke is present, it can be difficult to determine if it was due to the pressurisation system or other factors. Examples of such factors include passive compartmentalisation or the fire not producing enough quantities of smoke to spread to the compartment of interest (due to automatic suppression, manual intervention or the fire simply not having sufficient fuel or oxygen to develop).

One way of looking at pressurisation system effectiveness is to compare tenability outcomes in buildings with and without pressurisation systems. However, fatalities and injuries due to fire and smoke are uncommon in the types of buildings that may implement escape route pressurisation systems. Most of the fatalities and injuries that do occur are also associated with people who were intimate with the fire and who escape route pressurisation systems are not capable of protecting. There are often many other factors involved with fatalities and injuries so it is difficult to establish what the contribution of the pressurisation systems to the outcomes was. An example is the June 2017 Grenfell Tower fire (Lane, 2018). The Grenfell Tower had a lobby smoke ventilation system installed but would not have been designed to protect the occupants against the conditions experienced in that particular fire.

Proxy measurements of pressurisation system effectiveness can be made by activating the system and measuring pressure and flow to determine if it is achieving the performance criteria specified in the relevant system design standard. These measurements may be taken during commissioning, routine system tests and/or at other times.

1.5 Prior estimates of pressurisation system effectiveness

Several attempts have been made to estimate pressurisation system effectiveness. The following section discusses those most relevant to the current study.

Fazio (2007) conducted a comprehensive study of two hypothetical stairwell pressurisation systems, one with a variable speed drive (VSD) fan and the other with barometric dampers to control the stairwell pressure. The two systems were nominally based on the design of two real systems in buildings in Melbourne, Australia. As part of her study, Fazio conducted a survey of industry personnel to get component reliability probabilities and modelled the systems under varying wind, temperature and leakage conditions using CONTAM.

A brief discussion of the testing and maintenance history of the real systems was included. The first system, located in an 8-storey building and that used a VSD fan, was approximately 20 years old at the time of Fazio's research. The commissioning data and first 15 years of maintenance and testing data was not found. The second system, located in a 54-storey building, was approximately 15 years old at the time of

Fazio's research. Both systems were re-evaluated against the 1998 version of AS/NZS 1668.1. Common faults with both systems over the data found included:

- high door opening forces
- high stairwell pressures
- low airflow velocity readings
- pressure sensors not operating correctly
- noise not measured and/or measured correctly and/or failed noise criteria.

Other faults identified in the first system were:

- sealed relief paths
- VSD not operating at correct frequency
- slow equipment response
- incorrect cabling and loose sensors
- incorrect smoke detector configurations.

Other faults identified in the second system were:

- fans that did not start or restart
- damper problems
- doors not opened properly for airflow tests
- pressure sensors relocated
- excessive shaft penetrations/leakage
- environmental conditions affecting performance.

Fazio suggested that system effectiveness was not sensitive to temperature and wind variations, based on CONTAM modelling, but leakage was important. The temperature and wind conditions considered were based on meteorological data from Melbourne. Wind speeds up to 15 m/s and outdoor temperatures from 15°C to 30°C were considered. These conditions would not cover the full range expected in New Zealand cities, so Fazio's results are not entirely applicable to the New Zealand context.

When Fazio analysed the industry survey results using a fault tree approach, she found very low probabilities that the systems would operate effectively. The overall probability of failure Fazio predicted for the VSD-based system was 97.1% (or an effectiveness of 2.9%) and 95.1% for the barometric damper system (4.9% effective). The failure criteria included all of the AS/NZS 1668.1 criteria, including door opening forces for every door in the stairwell. Fazio did concede that a pressurisation system might perform substantively well, only failing certain criteria under specific circumstances that might not adversely affect overall fire safety outcomes.

It should be noted that, while Fazio completed a comprehensive study of two systems, it was largely a desktop study, with the final conclusions of effectiveness based primarily on modelling and industry opinion survey results. However, the list of faults associated with the actual systems provide anecdotal evidence that supports her findings.

Gravestock (2008) looked at fire safety system effectiveness for use in quantitative risk assessment. He noted that there were four potential sources for stairwell pressurisation system reliability, as shown in Table 2. In his study, Gravestock collected New Zealand survey data that built upon Fazio's methodology and combined this with component failure rate data and expert opinion values to estimate system reliability. Using this approach, Gravestock estimated stairwell pressurisation system effectiveness

could range from 6% to 84% depending on system design, commissioning, testing and maintenance. Uncertainty in system component reliability was another contributing factor to the wide range in estimated effectiveness.

Table 2. Methods for developing stairwell pressurisation system reliability estimates and uncertainty (from Gravestock, 2008).

Data	Analysis	Uncertainty
Fire service statistics	Statistical	High due to variation in basis, incompleteness and applicability
Component failure rates	Fault tree models	High due to limited component data and process industry origins
Maintenance/survey records	Event and fault tree models	High
N/A	Expert opinion	High

Gravestock listed critical components for pressurisation systems with likely failure modes, as shown in **Error! Not a valid bookmark self-reference.**. Two key observations can be made from this table. The critical components can be broken down into fire alarm system components, air-handling components and the interconnection between the two. Installation, training and commissioning are common risk factors to nearly all the critical components. This indicates that improving these aspects can increase confidence and reliability of pressurisation systems.

Table 3. Stairwell pressurisation system critical components and subsystems, failure modes, and risk factors (from Gravestock, 2008).

Component/subsystem	Failure mode(s)	Risk factor(s)
Fan	Disconnected Connected backwards	Training, commissioning
Damper	Incorrect installation	Training, commissioning
Door closure	Incorrect installation	Training, commissioning
Detector	Detector disconnected	Education, correct detector selection, analogue addressable detectors
	Detector covered over	Education, correct detector selection
	Detector blocked/dirty	Analogue addressable detectors
	Incorrect installation	Installation, analogue addressable, commissioning
Connecting wiring	Wiring fault	Installation, protection from mechanical damage, protection from fire damage
Control panel failure	Hardware failure Software failure Comms failure	Training, commissioning
Fire alarm panel	Panel isolated	Training, analogue addressable, commissioning, security
	Panel communication fault	Installation, commissioning
Power supply	Loss of power	Installation, commissioning, security
Alarm signalling	No signal generated	Alarm valve failure, signal generating device failure, communication failure

Lay (2014) provided anecdotal evidence that pressurisation system problems are often found during commissioning. This anecdotal evidence was both from personal experience and from discussions with fellow fire safety professionals. He also reported that the fire service from the UK, the USA, India and Europe had provided opinions that they do not trust pressurisation systems. Lay broke down the challenges facing successful pressurisation systems into four categories: design, commissioning, operation and legacy.

- **Design:** Estimation of leakage from the core. Successful operation relies on this estimate being accurate for the life of the building.
- **Commissioning:** Cannot take place until building is substantially complete. Problems that cannot be addressed by fine-tuning already installed equipment lead to substantial costs and delays. Often commissioned before final fit-out, which can affect leakage paths.
- **Commissioning:** Results are sensitive to environmental temperature and air movement conditions on the day of testing.
- **Operation:** Number of doors open at any one time is critical to determining peak fan flow rate. Assumptions made during design may not represent actual evacuation or firefighting conditions in real fires. Additional doors that are open may result in insufficient airflow to prevent smoke movement into the protected compartment.
- **Operation:** Conversely, closed doors create increased pressure that can make door opening forces excessive. It is very difficult to balance these two needs under dynamic evacuation or firefighting conditions and particularly in very tall buildings.
- **Design:** The above operational constraints result in practical height limitations that can be addressed by splitting tall vertical compartments into separate stacked compartments. These constraints are sometimes included in design guidance but not recognised in building regulations.
- **Legacy:** High-rise development has accelerated in emerging economies, but they may not have the requisite inspection, maintenance and management practices that are present in established economies.

Lay proposed "smoke flushing" systems as a more effective alternative. The approach used in these systems was proposed earlier by Harmathy of the National Research Council of Canada (Harmathy & Oleszkiewicz, 1987). The objective of these systems is to strategically vent smoke from key compartments such as corridors to protect more critical escape routes such as stairwells. It is unclear how many of these systems have been installed in New Zealand buildings because there is no way of differentiating them using the current specified system categorisation.

Beck and Yung (1990) created a cost and risk-assessment model for Canadian apartment buildings. They found negligible benefit for life safety from adding stairwell pressurisation systems but an increase in cost. They investigated scenarios that were sprinklered and non-sprinklered and with three levels of alarm reliability including no alarm.

2. Pressurisation system use in major New Zealand cities

For this pilot study, council data from the three major New Zealand urban centres (Auckland, Wellington and Christchurch) was used to determine the number of buildings with pressurisation systems in these cities. There was a total of 404 buildings identified in these cities that were listed with an SS5 escape route pressurisation system in their compliance schedule. The council data did not differentiate what type of escape path was pressurised (i.e. corridors, stairwells or combinations). Potential fire safety trade-offs in the building design as a result of installing the pressurisation systems were not identified.

2.1 Pressurisation and private fire alarm systems

For this pilot study, buildings with a private fire alarm (PFA) brigade connection to FENZ (referred to as a "direct connection to FENZ" in the New Zealand building regulations) were considered. FENZ PFA building and structure fire incident data on all buildings in the three urban centres was obtained. For each incident and building coordinate point from the FENZ data, the nearest pressurisation building coordinate was obtained. A threshold of 50 m was used to filter the results. This reduced list was then manually processed to check for near address locations.

A total of 9,484 PFA connections were listed at 8,258 unique addresses. Of the 404 buildings in the three urban centres reported as having pressurisation systems, 325 (80%) were identified in the FENZ PFA building data as having brigade PFA connections and 79 (20%) were not. This means that approximately 4% of the PFA-connected buildings in the three major urban centres have escape route pressurisation systems. There were 19 duplicate address entries in the FENZ PFA list that were not considered separately. The occupancies for the 79 buildings that did not have PFA data were investigated using the council data, online research and Google Street View. The breakdown of the occupancies for these buildings is listed in Table 4.

Table 4. Non-brigade connected buildings with pressurisation systems.

Occupancy	Number of buildings
Commercial – 4 storeys or fewer	16
Mixed use – 4 storeys or fewer	8
Residential – 4 storeys or fewer	37
Residential – 5–10 storeys	2
Commercial – 10–15 storeys	3
Demolished	8
Other*	5
Total	**79**

* Includes a fire station, prison gatehouse, tunnels and embassy.

Difficulties were encountered in aligning the council data with FENZ data. The addresses were not in the same format, and many addresses were not consistent between the datasets. Therefore, it was undertaken to match the building locations using geographical coordinates. Both FENZ datasets included the New Zealand Transverse Mercator 2000 (NZTM2000) coordinates. Coordinates were obtained for the council dataset addresses by comparing Google and Bing Map API output. Where there

were large distances between the coordinates determined by these two methods, manual review was undertaken. In most cases where manual review was required, it was found that the Google Maps API was more accurate. The median distance between the Google and Bing Map API locations was 13 m, with a standard deviation of 980 m. The maximum distance was 19 km in one case where there were two similar addresses in two distinct neighbourhoods.

Different PFA connections at the same address are likely a result of different fire alarm systems in separate buildings or occupancies at the same address. It is not generally clear which system may correspond to a pressurisation system listed by the council in these instances. Other than common place names, the FENZ incident data did not provide an indication of which PFA connection would be associated with the pressurisation system listed by the council. Most of the council data did not include the common place name.

2.2 PFA-connected buildings fire incident comparison

Data for PFA-monitored incidents classified as structure fires was obtained from FENZ for the period 1 January 2006 to 28 September 2018. There were 6,359 total PFA-monitored incidents across New Zealand during this time period.

The incident data obtained from FENZ did not specify the urban area. Therefore, the incidents were filtered to the three major New Zealand city councils by obtaining the 2017 urban areas from Statistics New Zealand for the Wellington and Christchurch zones and the 2019 regional council boundaries for Auckland and overlaying the PFA building NZTM2000 coordinates. After filtering, it was determined that 3,497 of the incidents occurred in the three major cities. This equates to one incident per approximately 2.7 PFA connections or 2.4 unique addresses where PFA connections were found. Of these incidents, 770 (22%) were classified as "structure fire with damage".[1] 22 incidents were classified as "structure fire (NEW)", but none of these had any useful data recorded other than location, despite one event being labelled as a third alarm incident. Reviewing a selection of FENZ dispatch reports for these incidents did not provide any further insight. Therefore, they were removed from the dataset.

There were 310 PFA-monitored structure fire incidents at addresses where pressurisation systems were present in buildings with PFAs. This equates to approximately one incident per PFA connection. This is about three times higher than for PFA-monitored buildings without pressurisation systems. The reasons for this are unclear but probably related to the building typology where pressurisation systems are more likely to be installed. For instance, large low-rise industrial or commercial facilities could have PFA connections but would be unlikely to have pressurisation systems. Pressurisation systems are more likely to be found in mid-rise or high-rise buildings, which are more likely to be residential. Of these incidents, 64 (21%) were classified as "structure fire with damage". This percentage was consistent with the overall population of buildings with PFAs.

The breakdown of general building types is shown in Figure 1. Pressurisation systems are more commonly found in residential buildings when compared to the general building population. Figure 2 shows that sprinklers were much more likely to be the fire detector when damage was reported. As would be expected, alarm levels (representing the amount of fire service resources required) were higher when damage was reported

[1] FENZ classifications are listed in Appendix A.

(Figure 3). Alarm level differences between pressurised and non-pressurised buildings were not significant.

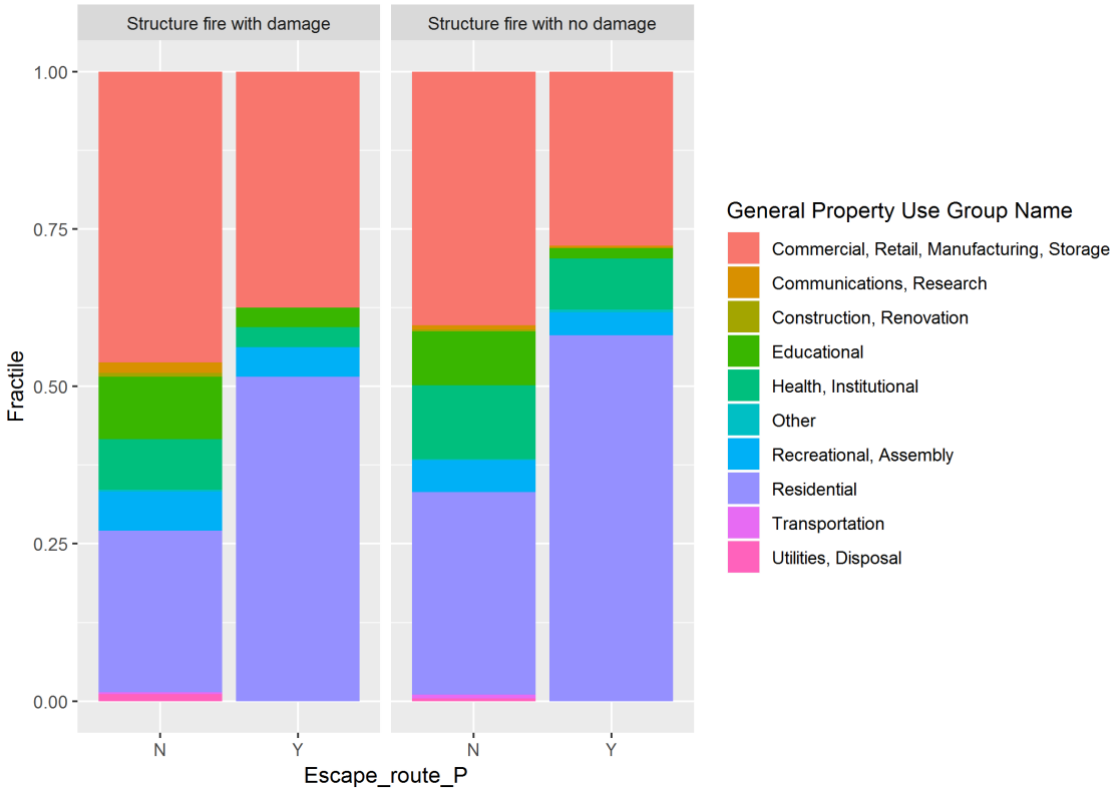

Figure 1. General building classifications.

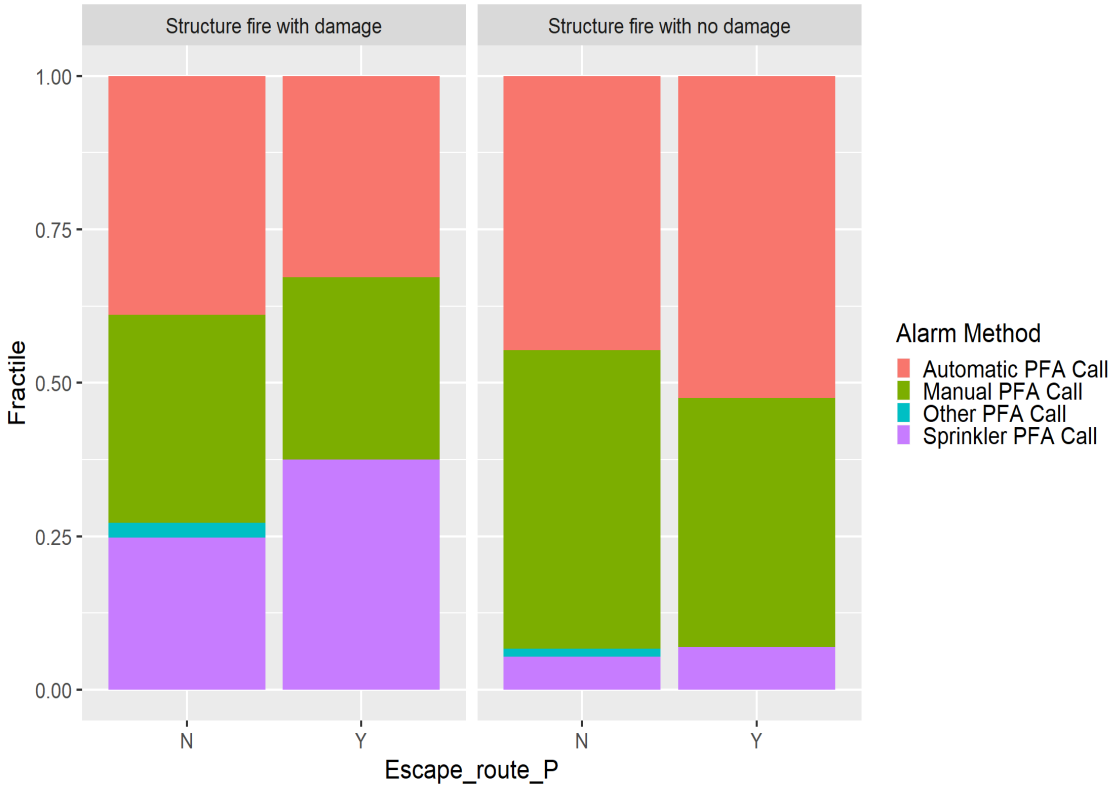

Figure 2. Alarm method.

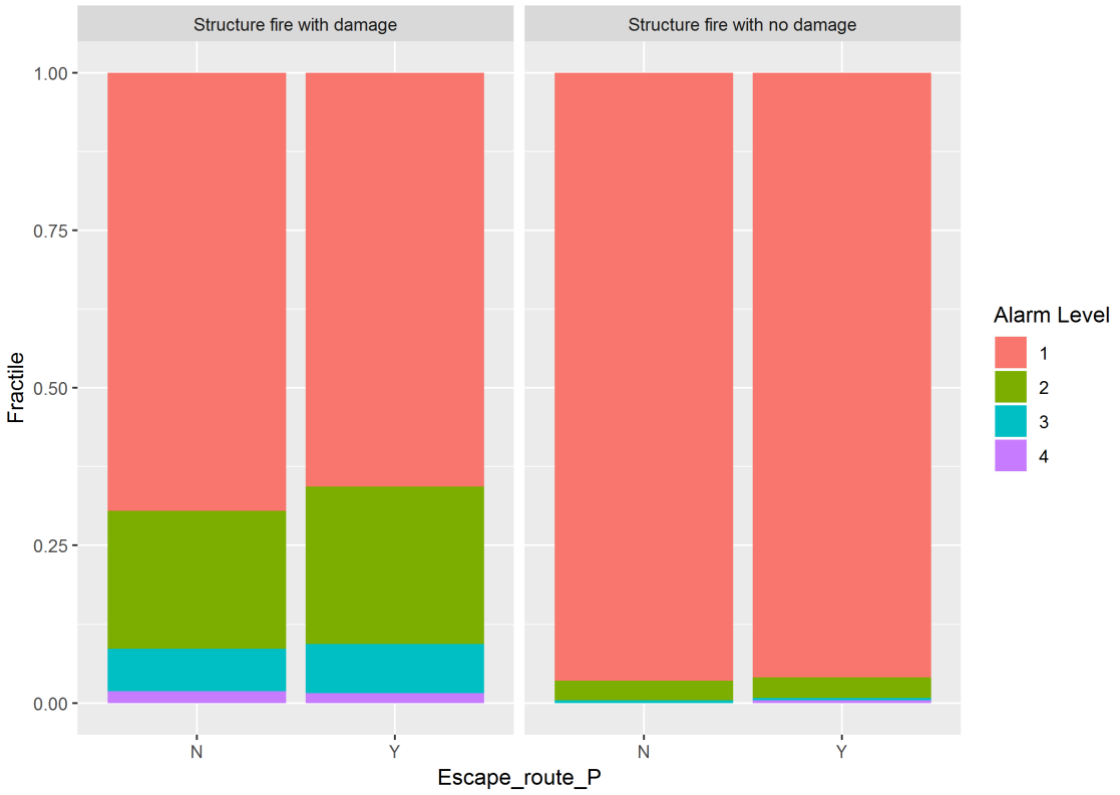

Figure 3. Alarm levels.

Recorded arrival conditions are shown in Figure 4. As would be expected, no incidents recorded as "structure fire with no damage" were classified as large fires, although a not insignificant number were classified as "small fire" or "smoke only". Incidents recorded as "structure fire with damage" did include "out on arrival" and "no fire or smoke", but that assessment may have changed over the course of the incident. Arrival conditions only reflect the observations of the attending firefighters when they arrive on scene. The fraction of "structure fire with damage" incidents where a "large fire" was reported as the arrival condition was higher in buildings without pressurisation systems compared to buildings with pressurisation systems.

Figure 5 shows the recorded number of sprinklers activated. There were no "structure fire with no damage" incidents that recorded any sprinklers activated, as may be expected. A larger fraction of "structure fire with damage" incidents had sprinklers recorded as activated where buildings had pressurisation systems and with fewer numbers of sprinklers reported activated. This is consistent with the fact that a higher fractile of incidents in buildings with pressurised systems occurred in residential buildings. Residential buildings are typically more highly compartmentalised and with relatively small compartments, so fewer sprinklers would be expected to operate. While the fraction of buildings either with pressurisation systems or without that have sprinklers installed is unknown, it is considered likely that the fraction of buildings with pressurisation systems that have sprinkler systems may be higher when compared to all buildings. This observation is also consistent with the observation from Figure 4 that buildings without pressurisation systems were more likely to have fires where the arrival condition was reported as a "large fire".

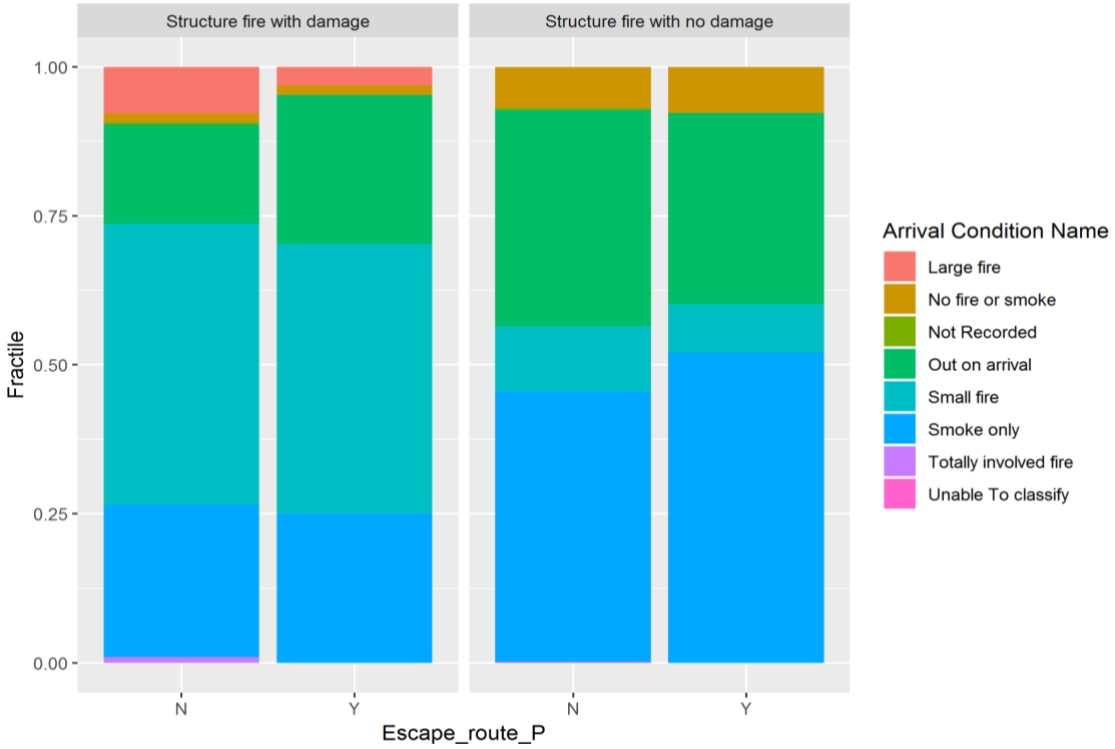

Figure 4. Arrival condition.

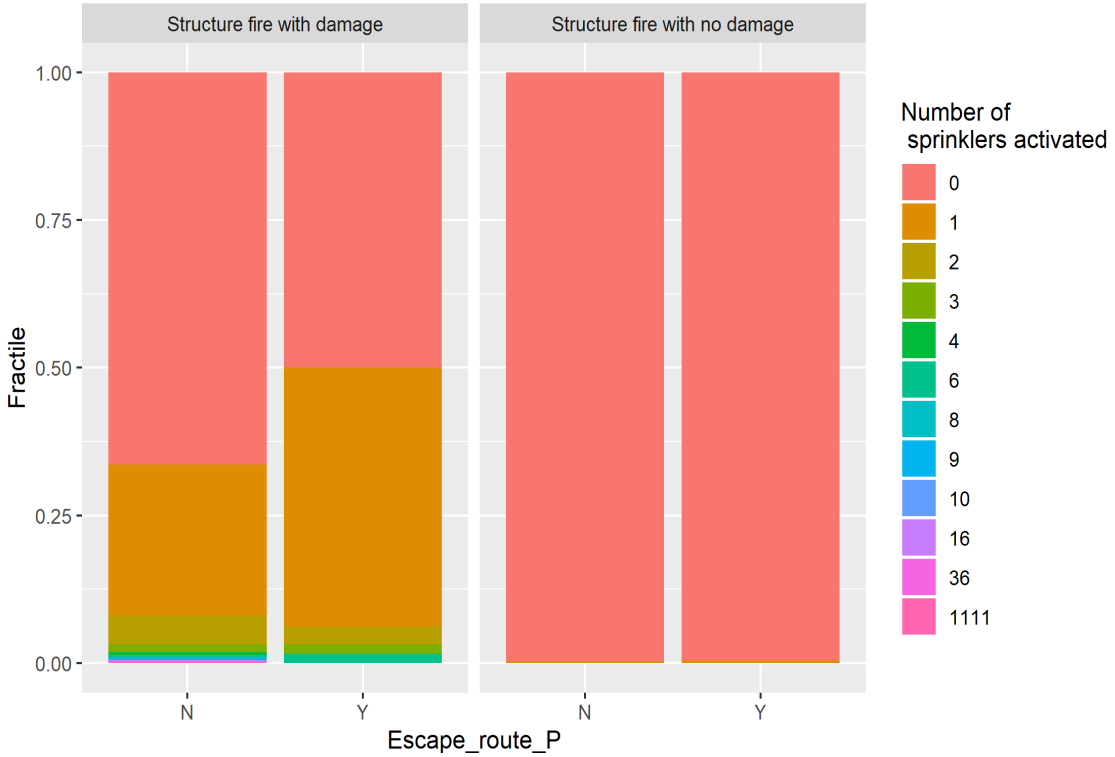

Figure 5. Sprinklers activated.

One incident reported 1,111 sprinklers activated in a building without a pressurisation system. Review of the dispatch report indicated that this was a sprinkler-controlled fire in a large, high ceiling height exhibition space. The correct number of sprinklers activated is unknown, likely to be multiple sprinklers but far fewer than 1,111 (i.e. it is probably a typographical error).

The extent of flame and smoke damage reported is shown in Figure 6 and Figure 7.

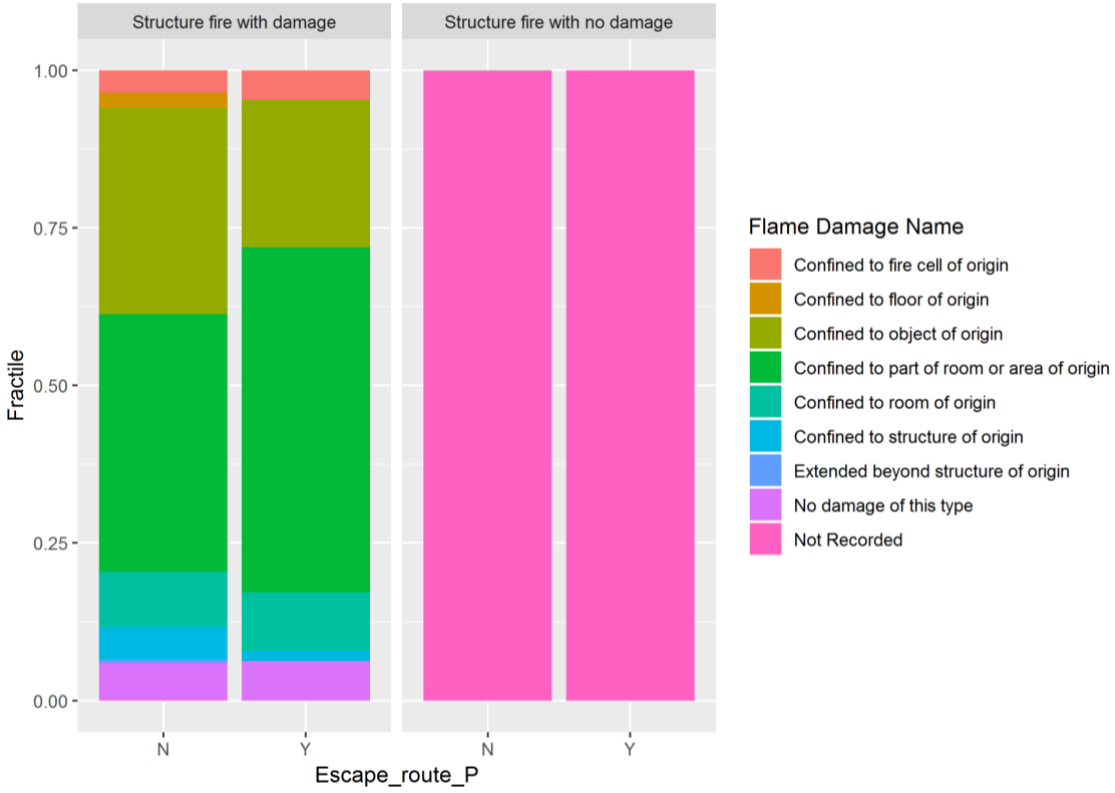

Figure 6. Extent of flame damage.

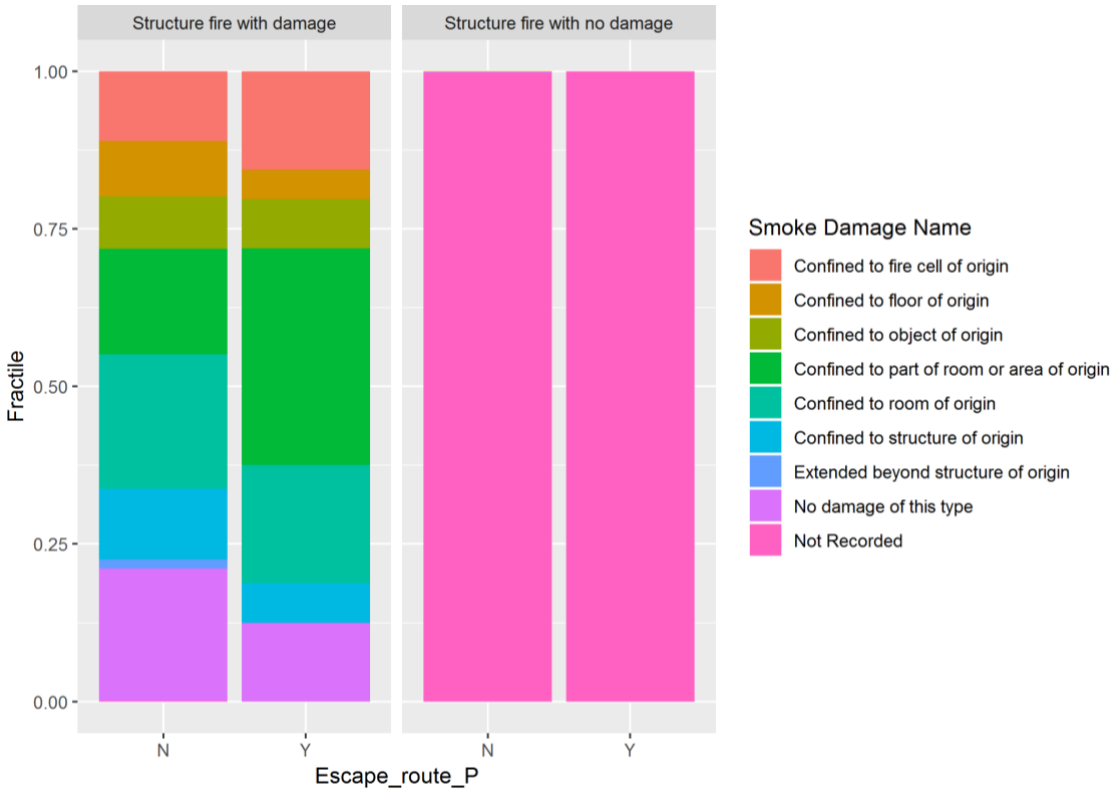

Figure 7. Extent of smoke damage.

In both cases, no incidents classified as "structure fire with no damage" recorded any smoke or flame damage. This could be a result of the reporting system locking these fields out if "structure fire with no damage" is chosen. Reported flame damage was similar in buildings with and without pressurisation systems. However, smoke damage was reported to be considerably more contained in buildings with pressurisation systems. The fraction of incidents with smoke damage confined to the floor of origin and the structure of origin was much lower for buildings with pressurisation systems. Conversely, the fraction of incidents with smoke damage reported confined to part of a room or area of origin or fire cell of origin was much higher in buildings with pressurisation systems.

Since the proportion of incidents in buildings with pressurisation systems classified as residential was significantly higher than for incidents in buildings without pressurisation systems, residential buildings were next separated from non-residential for incidents classified as "structure fire with damage". Figure 8 shows that sprinklers were slightly more likely to be the alarm method in residential buildings. In Figure 9, we can see that very few residential building fires reach third alarm or higher compared to non-residential buildings. It can be seen in Figure 10 that large fires on arrival tended not to be found in residential buildings. Activated sprinklers were more likely to be recorded in residential buildings and both more often and fewer in number in buildings with pressurisation systems (Figure 11).

Flame damage in residential buildings tended to be reported as more confined than in non-residential buildings, shown in Figure 12. Residential buildings are typically highly compartmentalised, which would contribute to confined flame damage. As with the overall population, both residential and non-residential buildings were reported as having smoke spread to the floor, entire structure or beyond less often when pressurisation systems were present (Figure 13).

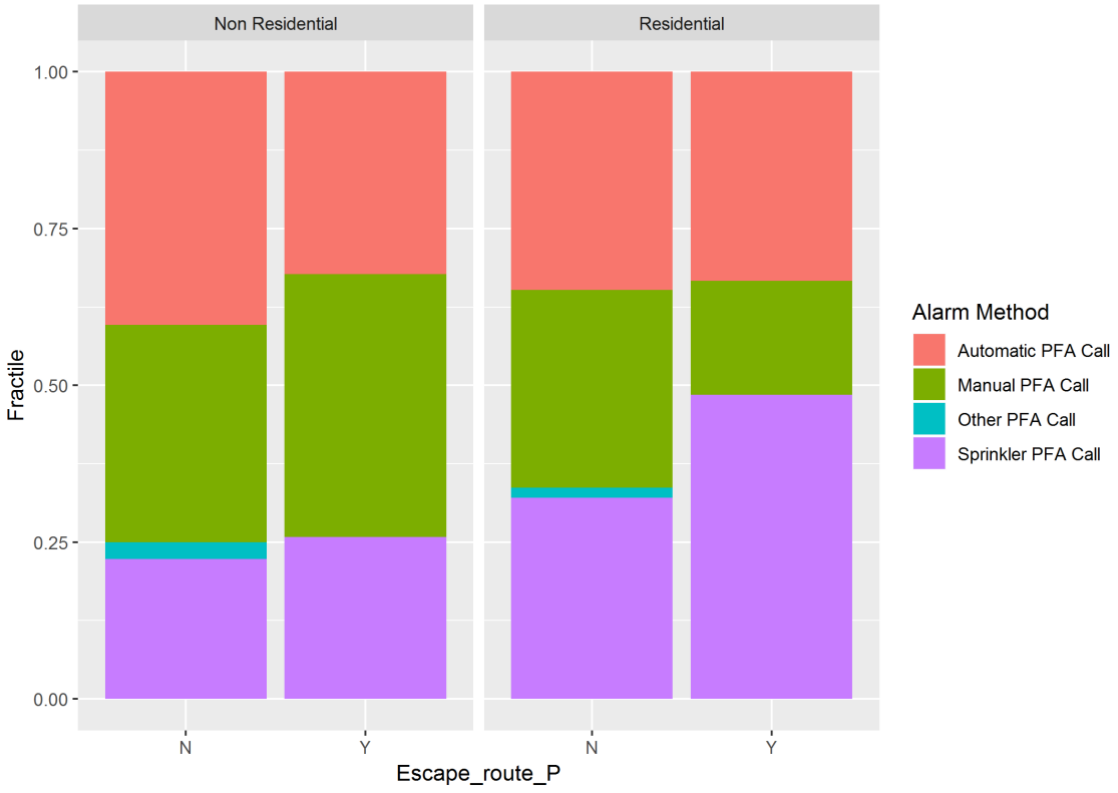

Figure 8. Alarm method (residential and non-residential).

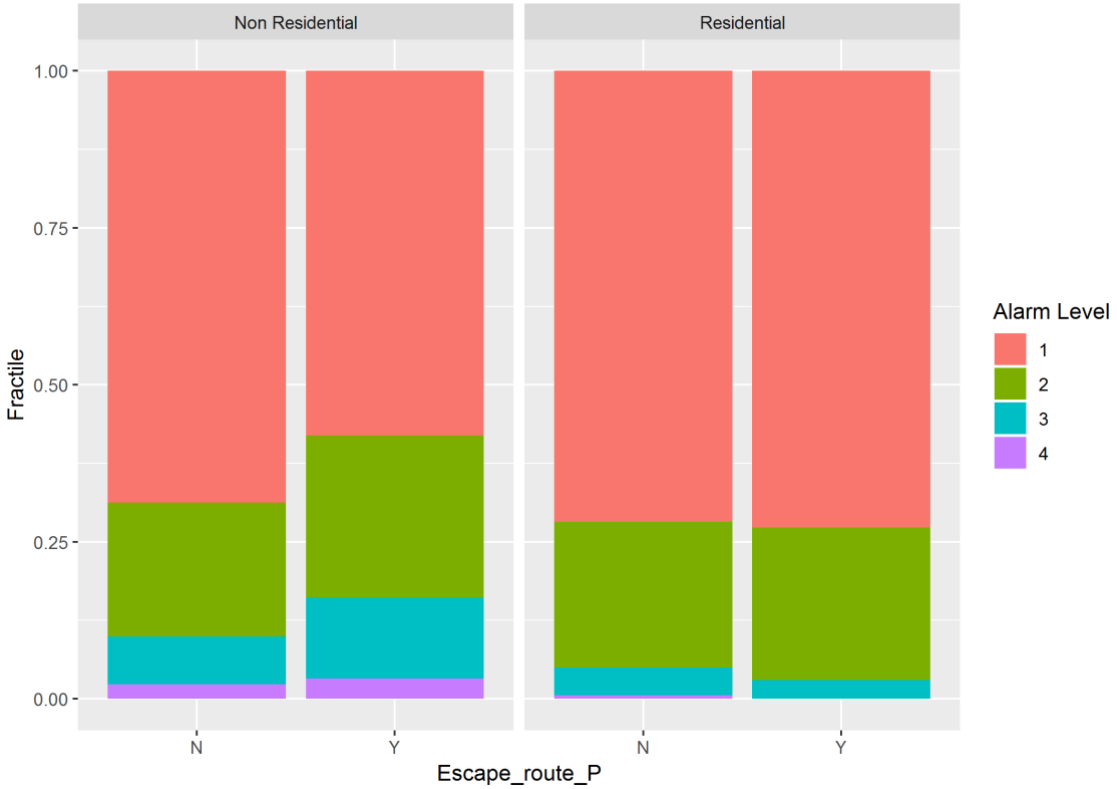

Figure 9. Alarm level (residential and non-residential).

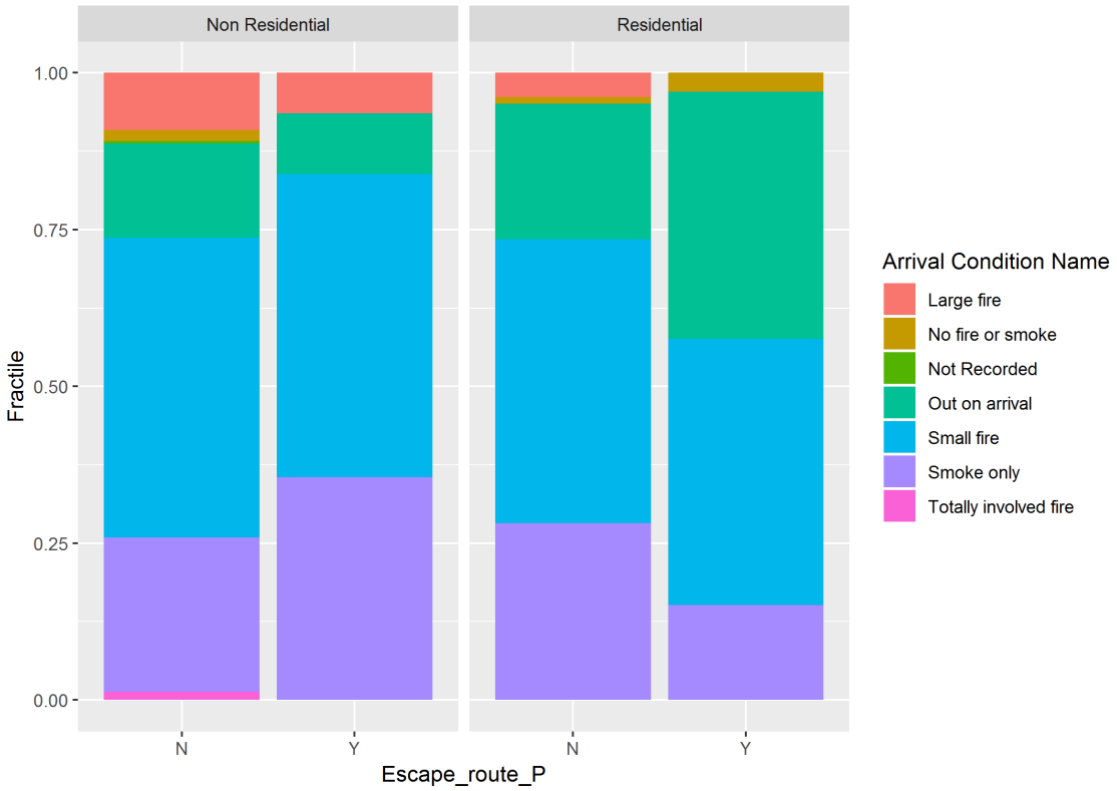

Figure 10. Arrival condition (residential and non-residential).

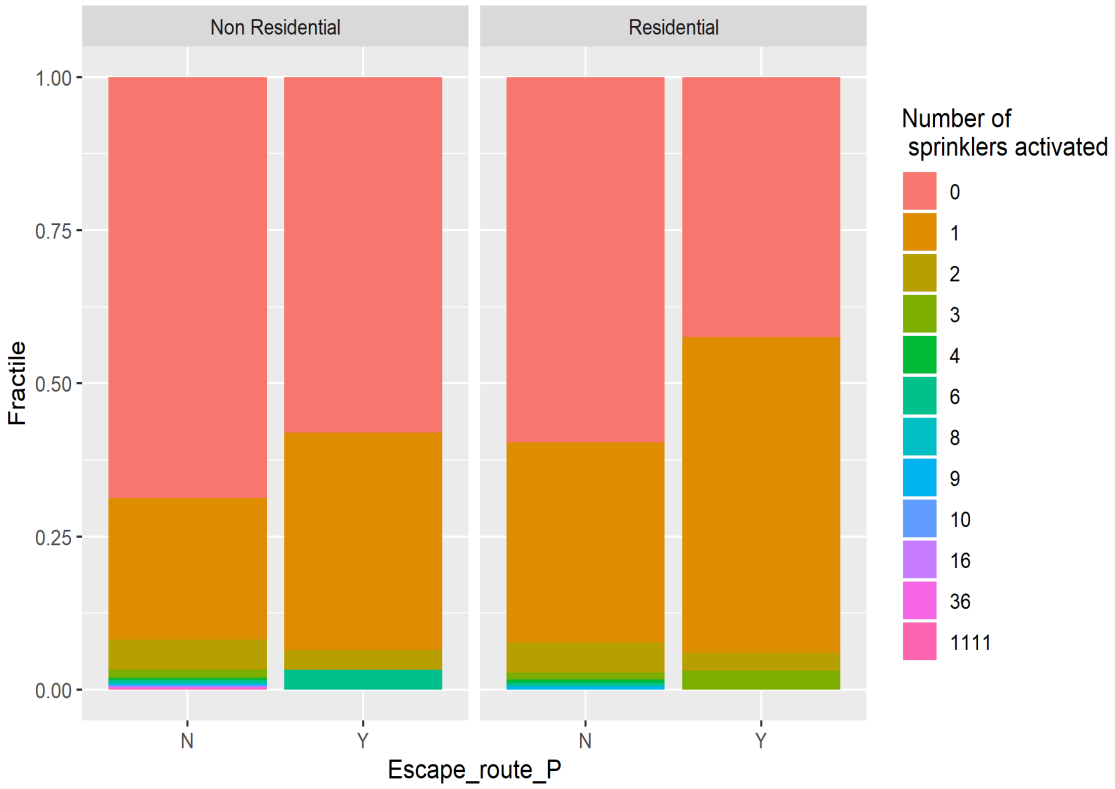

Figure 11. Sprinklers activated (residential and non-residential).

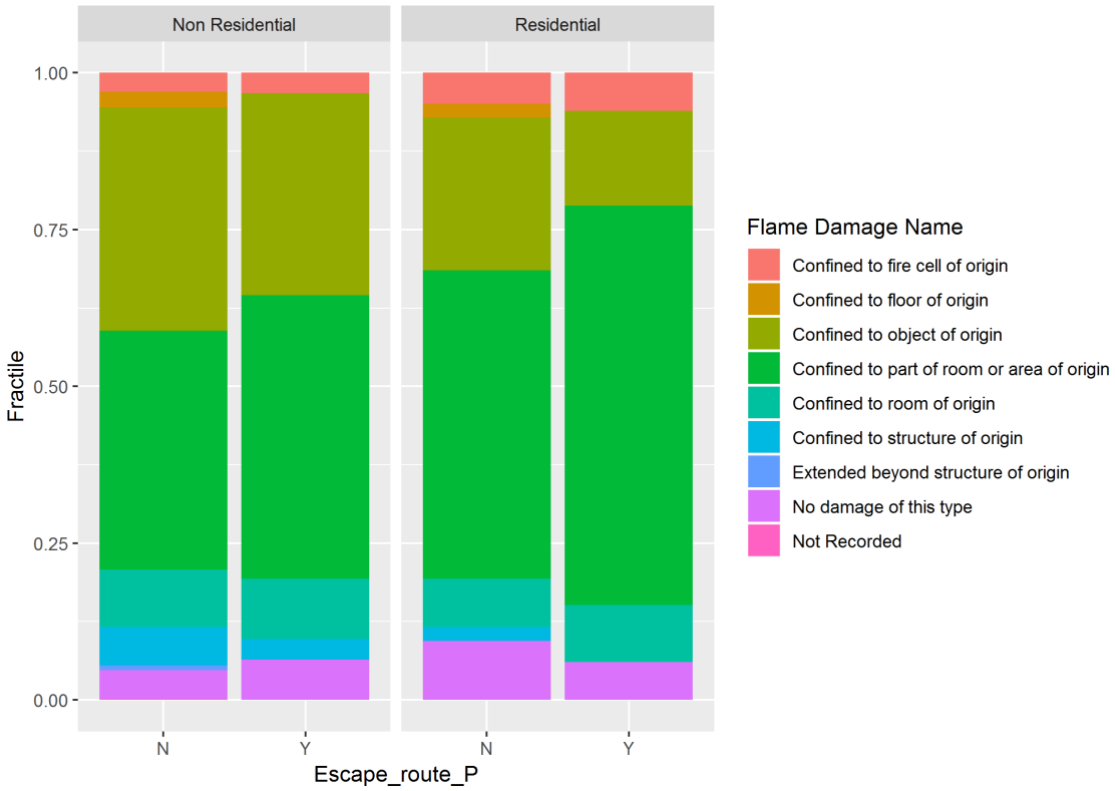

Figure 12. Flame damage (residential and non-residential).

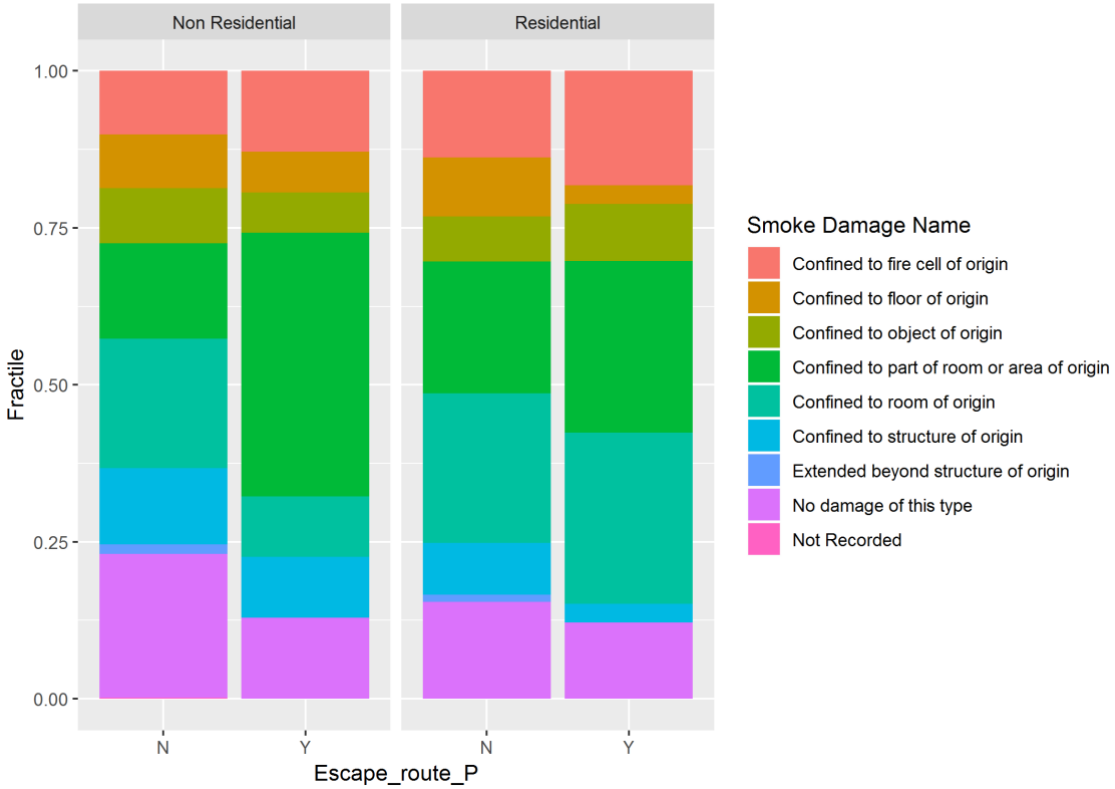

Figure 13. Smoke damage (residential and non-residential).

The FENZ fire incident database contained little useful information about the effects on occupants. Relevant data fields available included civilians assisted (Figure 14), extricated (Figure 15) and rescued (Figure 16).

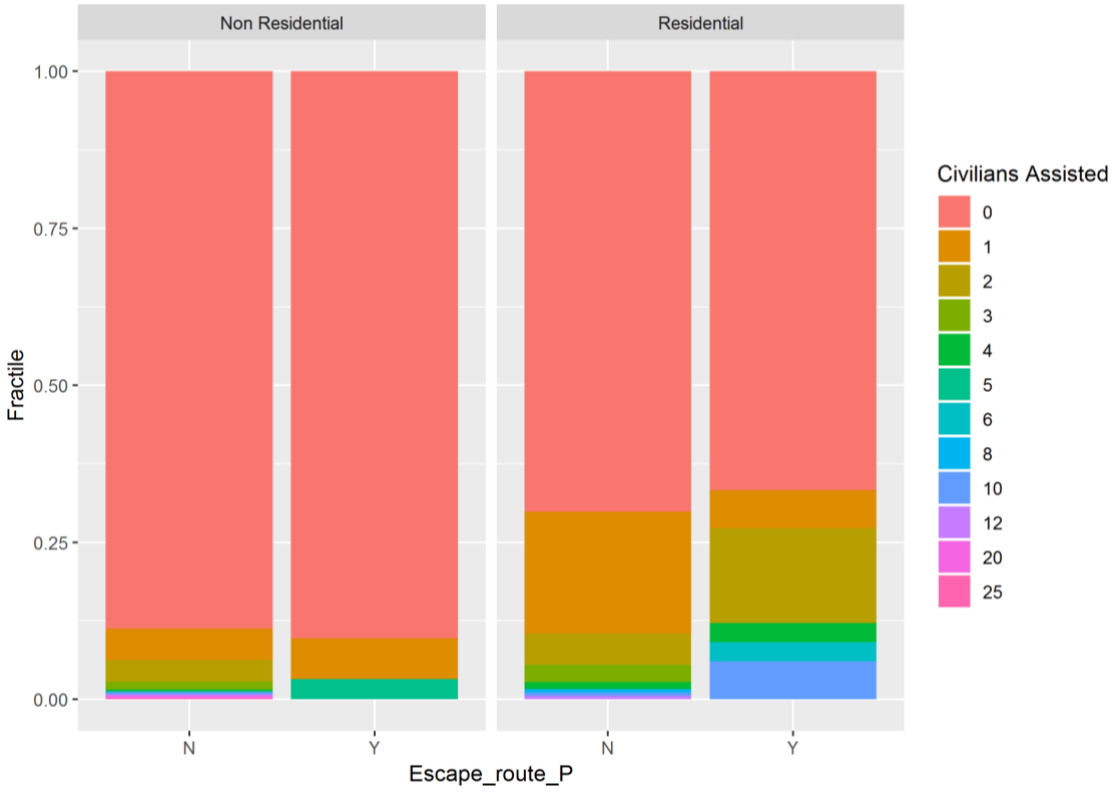

Figure 14. Civilians assisted.

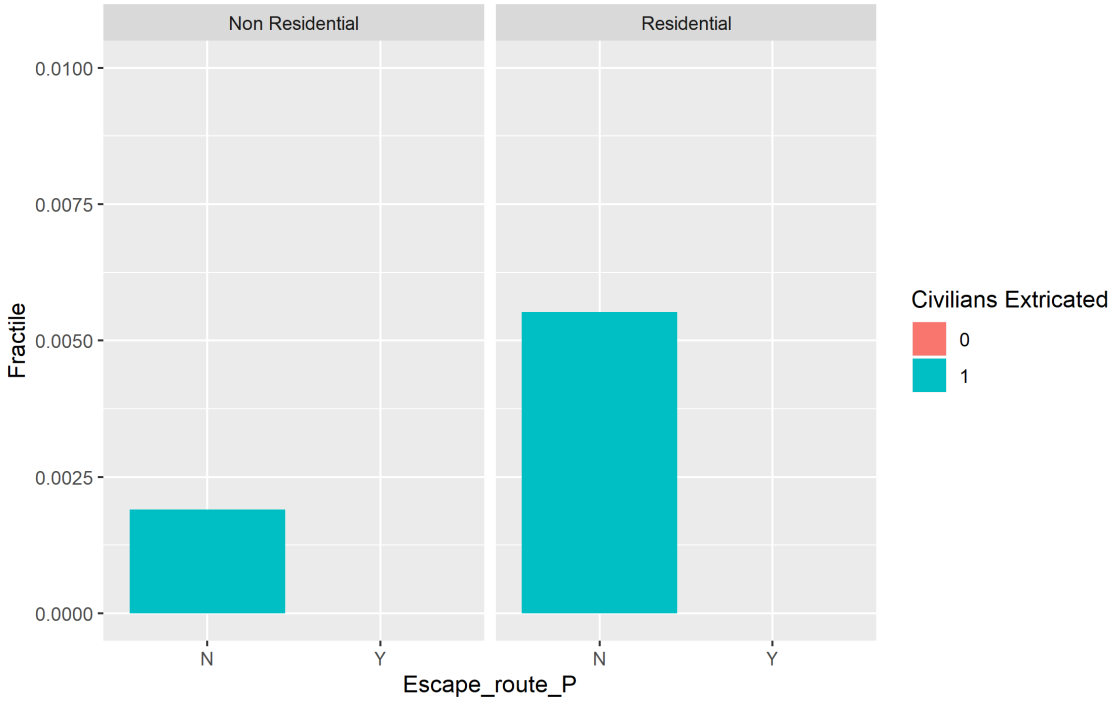

Figure 15. Civilians extricated (note fractile axis scale).

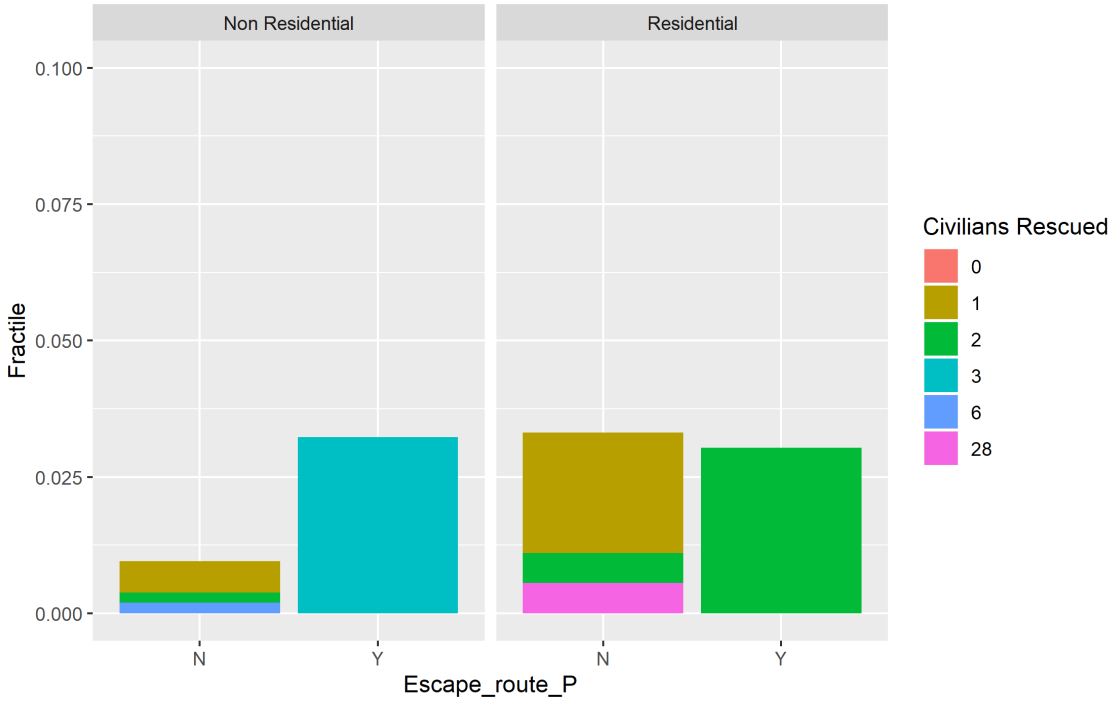

Figure 16. Civilians rescued (note fractile axis scale).

In general, civilians were assisted more often in residential buildings, and pressurised buildings tended to have higher numbers of civilians both assisted and rescued. However, this was likely skewed by two incidents in pressurised residential buildings that each reported 10 civilians assisted. Out of 422 structure fire incidents (with and without damage) where civilian assistance was recorded, 49 (11.8%) occurred in buildings with pressurisation systems. This was a higher percentage when compared to the total of 310 (8.9%) structure fire incidents in all pressurised buildings. Table 5

breaks down the structure fire incidents where civilian intervention by the fire service was recorded by residential and non-residential occupancies and buildings with and without pressurisation systems. The table shows that proportionately more fire incident reports in all residential buildings recorded civilian assistance and to a lesser extent in buildings with pressurisation systems.

Table 5. Structure fire incidents where civilian intervention by the fire service was recorded.

	Residential				Non-residential				
	Pressurised		Non-pressurised		Pressurised		Non-pressurised		Total
Total incidents	176	5%	972	28%	134	4%	2,193	63%	3,475
Civilians assisted	36	9%	153	36%	13	3%	220	52%	422
Civilians rescued	1	6%	8	47%	1	6%	7	41%	17
Civilians extricated	0	0%	2	67%	0	0%	1	33%	3

2.2.1 Computer aided dispatch report review

Computer aided dispatch (iCAD) reports were reviewed for the 49 incidents in pressurised buildings where civilians were reported as being assisted. These reports also included the two incidents where civilian rescues were reported. Of these 49 incidents, 35 (70%) were recorded as structure fires with no damage. On review of the iCAD reports for these 35 incidents, 23 were eliminated for further investigation because the iCAD information indicated that they were false alarms or involved the smell of smoke only, were a small kitchen fire or burnt food or were smoke only as shown in Table 6.

Table 6. Structure fire with no damage incidents in buildings with pressurisation systems where civilian assistance was reported and not reviewed further.

Category	Number of incidents
False alarm or smell of smoke only	6
Small kitchen fire or burnt food	13
Smoke only	4
Total	**23**

Summaries of key reported parameters as well as short narratives based on review of the iCAD incident communications are included in Appendix B. A discussion of notable case studies is included here.

Fire record 1 describes a small fire on arrival in an unsprinklered apartment building where a smoke detector has operated. Flame damage is reported as contained to the fire cell of origin, while smoke damage is reported as contained to the structure of origin. In the notes, it is indicated that residents of the apartments either went to the roof or were unable to evacuate due to smoke logging. Smoke travel is indicated in the stairwell or lift shaft. This appears to indicate that the pressurisation system was not effective at keeping the escape route clear.

Fire record 4 describes a small fire on arrival in a sprinklered apartment building. One sprinkler is recorded as being activated and effective. Despite the sprinkler system controlling the fire, smoke is reported in the hallways, and it appears smoke spread to the floor above. Smoke damage is reported as confined to the fire cell of origin, but the avenue of smoke damage is recorded as being through an open door. While it is unclear if the hallways were pressurised and what the path for smoke travel to the upper floor was, this could also indicate an ineffective pressurisation system.

Fire record 30 describes smoke only on arrival in an unsprinklered temporary residence building (hotel or otherwise). Smoke is reported on level 8, while the fire was located on a stove on level 9. This could indicate smoke movement through a stairwell due to an ineffective pressurisation system.

2.3 Fire incident data conclusions

The population of buildings with pressurisation systems in the three major New Zealand municipalities is approximately 400. As fire incidents are quite rare and not all fires may challenge the building fire safety systems to the point where an ineffective pressurisation system would adversely affect fire outcomes, the meaningful dataset to evaluate pressurisation system effectiveness is quite small. Even when adverse life safety outcomes were recorded, in most cases, the people affected were in the compartment of fire origin (as would be expected). The life safety outcomes for these people would not be expected to be improved by a pressurisation system since they are only designed to protect people egressing the building in safe paths. This study was also not able to determine what trade-offs may have been made in adding the pressurisation systems to the design of the buildings.

Flame damage (Table 7) and smoke damage (Table 8) reporting does appear to indicate that pressurisation systems have some success at limiting fire and smoke spread in buildings, particularly in residential buildings. The small number of residential fires with flame damage reported beyond the compartment of origin means that these numbers are likely optimistic. The smoke damage comparisons, ranging from 38% improvement in smoke spread in non-residential buildings to 69% in residential buildings, are more meaningful. These estimates are broadly in line with Gravestock's estimates from New Zealand survey data (Gravestock, 2008). However, it is impossible to determine from the fire incident data whether fire and smoke spread beyond the compartment of fire origin occurred into a pressurised compartment or not. This makes quantifying pressurisation system effectiveness more precisely difficult.

Table 7. Reported flame damage comparison.

Flame damage – floor and beyond	**Residential**	**Non-residential**
No pressurisation system	5%	10%
Pressurisation system	0%	3%
Improvement	100.0%	64.8%
Flame damage – structure and beyond	**Residential**	**Non-residential**
No pressurisation system	2%	7%
Pressurisation system	0%	3%
Improvement	100.0%	52.1%

Table 8. Reported smoke damage comparison.

Smoke damage – floor and beyond	Residential	Non-residential
No pressurisation system	22%	29%
Pressurisation system	7%	19%
Improvement	68.8%	36.1%
Smoke damage – structure and beyond	**Residential**	**Non-residential**
No pressurisation system	11%	18%
Pressurisation system	3%	11%
Improvement	68.8%	37.7%

3. Specific building information

An exploratory exercise to delve into individual building and system details was undertaken. Information on six individual buildings with pressurisation systems was obtained from Auckland Council via property file requests. A site visit was undertaken in conjunction with Auckland Council staff to a building with a pressurisation system that had failed a 2017 BWoF inspection in Auckland. Two IQPs who inspect and test pressurisation systems were also interviewed.

3.1 Property file review

The six buildings were chosen in consultation with Auckland Council and the FENZ Engineering Unit. Half of the buildings had also been the subject of Department of Building and Housing determinations in 2005/06. The primary issue addressed in these determinations was the use of a single means of escape for high-rise residential occupancy. To compensate for using a single means of escape rather than having multiple escape paths, several fire safety system upgrades were proposed including adding escape route pressurisation systems. The determinations noted that the fire safety of the proposed designs was particularly sensitive to the pressurisation system performance. Extra measures were recommended to ensure that the pressurisation systems would be effective when called upon.

The original consented date for all six buildings pre-dated the 2012 introduction of C/VM2 and simplified C/ASx approach. Two of the buildings were constructed prior to 1991 under NZS 1900 *Model building bylaw* and were primarily used as commercial buildings, although one of them was under development for conversion to residential at the time this research was conducted. The other building had undergone numerous fit-outs with associated fire engineering reports over its lifespan. Four of the buildings were constructed in the mid-2000s with three designed as Alternative Solutions in terms of compliance with the NZBC fire safety clauses. The other appeared to be designed to C/AS1. All four of these buildings were residential.

It was a monumental task to sort through the property files to extract meaningful information regarding the pressurisation system design, operation, inspections, testing and maintenance. A total of 8,854 documents were included in the property files for the six buildings – an average of 1,476 per building. The property file information was provided as scanned PDFs, which makes automating the task difficult. This report provides some preliminary observations based on a partial scan of this material.

In general, design information for the pressurisation systems was limited. It did not appear that any of the buildings had been modelled using a tool like NIST's CONTAM network model, which that is used to design and balance pressurisation systems. This model is referenced in many international guidance documents on pressurisation system design (Klote, 2016; Klote, Milke, Turnbull, Kashef & Ferreira, 2012), is used widely internationally and is freely available. As a comparison, NIST's Fire Dynamics Simulator (FDS) computational fluid dynamics model, which is also freely available, is used widely in New Zealand for building fire safety design. Fan capacity was usually based on the nominal 1 m/s flow required through the doors specified by AS/NZS 1668.1. In some cases, relief air paths and leakage were discussed, but not in all. Leakage considerations and different door opening scenarios were generally not modelled to investigate how the pressure differences and velocities could be

maintained during a fire event, considering occupant evacuation and fire service intervention.

Very little to no data on initial system commissioning was found. In some cases, the door velocities had been reported but not door opening forces or noise levels. It is unclear how much design and/or commissioning information may exist but not be entered into the property file system, so a lack of information in the property file does not prove that it was never done or documented. However, it does raise questions about the adequacy of the system when little documentation is available.

In some cases, the BWoF was reported as overdue. There were also multiple instances where a report in lieu was issued instead of the BWoF. Reasons for either case included insufficient evidence of required inspection and maintenance work done in the preceding period, relief vents not working properly and problems with the back-up power supply.

3.2 Auckland pressurised building site visit

The building that was visited in Auckland was a 3-storey commercial building. The timing of this visit was in September 2018 (the BRANZ visit). The basement floor was a carpark with individual tenanted spaces on the upper two floors. The escape route was comprised of a single open stairwell with connecting corridors to the individual tenanted spaces. A single fan, installed in 2004, was intended to pressurise the escape route from the roof of the building. The space above the top floor suspended ceiling was used as a plenum for the fan, with no ducting present and a few ceiling tiles replaced with grilles. When the fan was activated during the BWoF inspection in 2017, the fan was found to be running in reverse, extracting air instead of supplying air, and there was no form of pressure control found to maintain the required pressure differential. At the time of the BRANZ visit, the fan was running in the correct direction. If the fan is running in reverse, it would act to pull smoke through the safe path and exhaust it. The fan performance in reverse is unclear, and the effect on life safety would depend on the quantity and buoyancy of the smoke.

Correspondence with the fire engineer in 2004 indicated that perimeter wall and HVAC leakage was intended to be sufficient for the system needs. However, this was questioned by other parties. No other relief ventilation appeared to be installed at the time of the BRANZ visit.

Doors to individual tenanted spaces opened from the escape route into the tenanted spaces, meaning they opened opposite to the direction of egress flow. It was noted that some of these doors were not able to latch properly when the fan was activated during the BRANZ visit. This is a failure under the AS/NZS 1668.1:1998 performance criteria. It was not determined if this was due to insufficient door closer force or excessive fan flow.

3.3 IQP interviews

Two IQPs who inspect buildings with pressurisation systems were interviewed to discuss their general findings during inspection. The first IQP noted that most of the pressurisation system problems they had encountered had been mechanical. This included a non-operational fan, cases where the fan speed or pressure switches needed adjustment and instances where doors were too hard to open with the system operating. Most of the systems they were familiar with were in apartment buildings,

with a few also in offices, although they did not have exact numbers of systems they had encountered.

The second IQP regularly looked at three buildings with pressurisation systems. One of the buildings had a good system that, in their opinion, would be likely to work correctly under fire conditions, while the other two were more questionable. Problems they had encountered included fans moving air in the wrong direction and a lack of evidence of needed maintenance and testing work.

3.4 Specific building data conclusions

While limited, the specific New Zealand building information reviewed for this research supports literature evidence of widespread problems with pressurisation systems. The lack of evidence of robust design, commissioning, inspection and testing practices indicate that there is room for improvement in pressurisation system operational quality assurance. Approaches used for other active systems, particularly sprinkler and detection systems, could be adopted for pressurisation systems to improve fire safety outcomes. Having a system certifier role similar to the sprinkler system certifier required in NZS 4541:2013 *Automatic fire sprinkler systems* is one example. Third-party certification requirements are another. Required qualifications for designers, installers, inspectors and maintainers could be mandated to improve industry knowledge of pressurisation systems. The current standard usually referenced, AS/NZS 1668.1, does not have considerations for these aspects at the same level as NZS 4541:2013 for sprinklers or NZS 4512:2010 *Fire detection and alarm systems in buildings* for alarm systems. New Zealand influence into the current Australian AS/NZS 1668.1 is not likely to be sufficient to address these issues, so a new New Zealand standard may be the best option for the future.

4. Conclusions

This study represents an exploratory effort to collect fire incident and system data related to safe path pressurisation systems in New Zealand buildings. Council data from the three major New Zealand cities (Auckland, Wellington and Christchurch) indicated approximately 400 buildings have pressurisation systems. Over the period of 1 January 2006 to 18 September 2018, PFA-connected buildings with safe path pressurisation systems had on average approximately one incident classified as a structure fire. This was approximately 2.5 times higher incidence of structure fire incidents than all PFA-connected buildings.

The dataset of fire incidents in buildings with safe path pressurisation systems was quite small, and the reported incident data is quite coarse, so limited conclusions can be drawn from this analysis. Proportionately greater civilian assistance was reported in pressurised residential buildings, but this was skewed by two incidents that each reported 10 civilians assisted. Flame and smoke damage was reportedly less widespread in pressurised buildings. Reported smoke spread beyond the floor of fire origin was improved by approximately 38% in non-residential buildings and 69% in residential buildings with pressurisation systems.

A review of specific building pressurisation system information was undertaken by looking at property files for six buildings with pressurisation systems in Auckland, visiting a pressurised building and talking to two IQPs who inspect pressurisation systems. This exploratory exercise found similar system issues to previous reports in the literature. Highlighted issues include a lack of documentation, gaps in inspection and testing, problems with fan configuration, inadequate door closing action and questionable relief venting.

Overall, the conclusion from this study is that escape route pressurisation systems may provide some benefit in limiting smoke and flame damage spread beyond the compartment of fire origin, but confidence in current system performance in New Zealand buildings remains very low. The future recommendations section discusses some options to improve this situation.

5. Future recommendations

There is much that can be done to improve confidence in the ability of pressurisation systems to perform as expected. Future recommendations include design, installation, commissioning, inspection and testing recommendations that could be implemented in the next few years, longer-term regulation recommendations and ongoing pressurisation system performance monitoring recommendations. Research recommendations are targeted at obtaining better methods of collecting data on pressurisation systems, investigating the suitability of pressurisation system performance criteria and evaluating pressurisation systems against alternative design approaches.

5.1 Design

The design documentation of pressurisation systems found in property files was limited. This indicates that there are opportunities to improve the way pressurisation systems in New Zealand are designed to bring them up to international best practice. Key aspects that appear to be missed are the inclusion of realistic construction air leakage, the stack effect and modelling system sensitivity to changes in door positions. Guidance on how to implement best international design practices in New Zealand should be developed and pushed out to the industry using training and education programmes. Councils need to be made aware of the standard of evidence that should be supplied to ensure that the pressurisation system will operate as intended.

5.2 Installation, commissioning, inspection and testing

Installation, commissioning, inspection and testing have been identified as risk factors for pressurisation system reliability. These should be addressed by implementing more robust controls and training to ensure pressurisation systems will perform as desired when called upon. Sprinkler system and alarm system controls and processes already in place should be used as templates to develop new controls for pressurisation systems. These could include installation and commissioning standards and/or guidance and third-party certification requirements. Training and educational opportunities for proper pressurisation system installation, commissioning, maintenance, inspection and testing should also be developed. A body with an oversight function (similar to the sprinkler system certifier function required under NZS 4541:2013) may be necessary to ensure that measures are upheld by competent personnel.

System interdependencies can result in unknown effects on the overall fire safety outcomes. The Fire Protection Association of New Zealand (FPANZ) is currently developing a code of practice for integrated fire safety system installation and commissioning. When available and put into use, this may help to mitigate potential interdependency problems.

5.3 Regulations

Ultimately, aspects of the guidance discussed in sections 5.1 and 5.2 should be reflected in the New Zealand building regulations. These could include requirements for practitioner qualifications and reference to international standards. It is likely that changes to the regulations will take longer to implement than issuing guidance. Also, practitioner qualifications are difficult to regulate until there is a suitable pool of practitioners who have or would meet the qualification requirements.

5.4 Monitoring

The performance and state of escape route pressurisation systems should continue to be monitored through both fire incident data collection and monitoring documentation in property files.

A common building numbering scheme should be introduced that can be used to cross-reference between FENZ and council data. It is understood that Land Information New Zealand (LINZ) may be working on such a system, but it has not yet been made available or linked to FENZ and council data. A national compliance schedule numbering system might be another approach that would circumvent some of the problems with using common place names and/or street addresses.

A preferable step would be to implement a digital national compliance schedule/BWoF database that would also include inspection data. This would allow easy tracking of specified system installations and their status. This would be comparable to the New Zealand Transport Agency's Motor Vehicle Register, which contains vehicle specification details and inspection history.

Extracting useful knowledge from property files will require a better method of processing property file information. This is discussed further in section 5.5.

More detailed fire safety system auditing could be conducted on a sample population of New Zealand buildings. A process such as that described in AS 4655 could be used as a template. This undertaking would require substantial resources and the power to access buildings and information. It would be useful to better establish a baseline of current practices and could be revisited to establish a trend in expected system performance based on future required measures and practices.

5.5 Research

Property files are a potentially rich source of fire safety system performance data, but extracting useful data manually is very difficult. Emerging digital methods such as machine learning and artificial intelligence should be used to automate this task and allow for building a useful database of New Zealand buildings. Some councils have already allowed free and open access to their property file data. Other councils should be encouraged to do so as well by demonstrating the potential usefulness of the data.

A better indication of expected actual performance under fire conditions could be obtained by undertaking field measurements of key pressurisation system performance metrics during trial evacuations. Discussions with the IQPs did indicate that this may be viable in some instances. However, the cost of proceeding with this expansion is expected to be high relative to the incremental value of the information gained on pressurisation system effectiveness. Improving installation, commissioning and design practices would likely have more benefit.

Little evidence was found to support that designing pressurisation systems for 1 m/s door velocities is sufficient to stop smoke spread. For example, the statement given in AS/NZS 1668.1 only covers situations when a 500 mm transom is present. Additional research using both modelling and experimental work could be undertaken to improve understanding of key velocity and pressure differential performance criteria. Comparisons to alternative design approaches such as corridor flushing systems could also be undertaken using modelling and experimental approaches.

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Appendix A: FENZ data fields used and classifications

Note: These classifications are those found in the dataset. FENZ may have more options for each data field.

- **Incident type name**
  - Structure fire with no damage
  - Structure fire with damage
- **Arrival condition name**
  - No fire or smoke
  - Out on arrival
  - Smoke only
  - Small fire
  - Large fire
  - Totally involved fire
- **Alarm level**
  - Numerical, 1 to 4
- **Fire detector type name**
  - Smoke detector system (monitored)
  - Manual fire alarm
  - Sprinkler
  - Residential sprinkler
  - Heat detector, thermal detector
  - Smoke detector/security alarm system
  - Domestic smoke alarms
  - Domestic (HOME) sprinkler
  - Inert gas (not CO_2)
  - Deluge system
  - Drencher system
  - Smoke sampling system
  - Flame detector
  - CO_2
  - Water spray projection system
  - Dry powder
  - Foam
  - Halons (BCF, BTM, etc)
  - Not recorded
  - Unable to classify
- **Fire detector performance name**
  - System operated AND was EFFECTIVE
  - Alerted occupants - detector in room of origin
  - Not Recorded
  - Alerted occupants but detector not in room of origin

- Unable to classify
- Fire too small to activate detector in room of origin
- Did not operate - detector in room of origin
- Detector not in room of origin - Other
- Did not operate - detector not in room of origin
- Detector operated, but was not a factor in discovery of fire
- Alerted public - detector in room of origin
- System operated but was INEFFECTIVE
- Detector in room of origin - not classified above
- Detector operated - not classified above
- Detector in Room operated AND was EFFECTIVE
- Detector Not in Room operated AND was EFFECTIVE
- Detector operated, but occupants failed to respond
- Alerted public - detector not in room of origin

- **Number of sprinklers operated**
  - Numerical
- **Alarm method group**
  - PFA (private fire alarm) calls
- **Alarm method**
  - Automatic PFA call
  - Manual PFA call
  - Sprinkler PFA call
  - Other PFA call
- **Fire detector failure name**
  - Improper installation/Placement of detector
  - No discharge heads/detectors in room or space of fire origin
  - Detector not in room of origin
  - System shut down
  - Defective detector
  - Extinguishing agent discharged- did not reach fire
  - System tampered with
  - External Power supply failed
  - Extinguishing system piping damaged or blocked
  - Suppression system overwhelmed by fire
  - Defective discharge head or outlet
  - Not Recorded
  - Unable to classify
  - Unknown
- **General property use group name**
  - Commercial, Retail, Manufacturing, Storage
  - Health, Institutional
  - Residential
  - Transportation
  - Educational
  - Recreational, Assembly

- Construction, Renovation
- Other
- Communications, Research
- Utilities, Disposal

- **General property use name**
  - Office, Bank, Embassy, Fire/Ambo/Police station
  - Hospital, Hospice, Rest home, Rehab centre
  - Boarding/Halfwayhouse, Dorm, Homestay/Backpacker
  - Airport
  - Industrial, Manufacturing
  - Flat, Apartment, Home unit
  - Commercial - not classified above
  - University, Polytech, Other post-secondary venue
  - Hotel, Motel, Lodge, Timeshare
  - Library, Museum, Art gallery, Court etc
  - Service/Repair, Dry cleaner, Laundry, Workshop
  - Shop, Mall, Supermarket, Gas station, Sales, Other
  - Restaurant, Pub, Tavern
  - Recreational use, Theatre, Indoor sports, Pool, Park, Zoo, Aquarium
  - School: Pre-school through to Secondary/High
  - Construction, Renovation, Demolition site
  - Doctors/Dentists emergency clinic, Medical centre
  - Sportsfield, Stadium
  - Sports club, Health club
  - Single house
  - Defence, Military use
  - Community hall
  - Church, Cemetery, Religious use
  - Storage, Warehousing
  - Telephone exchange, Communications use, Data processing
  - Residential - not classified above
  - Road, Street, Motorway
  - Power station
  - Recreational, Assembly - not classified above
  - Educational, Health, Institutional - Other
  - Unable to classify
  - Studio: Radio, TV
  - Prison, Correctional institution
  - Rubbish tip, Transfer station, Haz Waste disposal
  - Vacant building, Section
  - Construction, Renovation - not classified above
  - Marae, Maori Culture use
  - Laboratory, Research use
  - Railway property

- **Specific property group name**
  - Office, Commercial Premise
  - Rest Home, Old Person's Home
  - Hotel, Motel, Lodge
  - Care of the Sick and Injured

- Passenger Terminal
- Manufacture: Metal, Metal Products, Electrical Machinery
- Flat, Home Unit, Apartment
- Prison, Correction Institution
- Commercial Property – not classified above
- University
- Library, Museum, Art Gallery, Courtroom
- Food, Beverage Industry
- Supplies and Services
- Food and Beverage Sales
- Manufacture: Textile, Leather, Rubber
- Department store, Shopping mall
- Boarding, Half-Way House, Dormitory
- Unable to Classify
- Recreational Place: Fixed Use
- Clothing, Shoe, Fabric Shops
- Manufacture: Wood, Cane Products, Paper Printing Products
- School: Non Residential
- Vacant Building, Construction Site
- School: Trade, Business
- Other Shops
- Care of the Intellectually Handicapped
- Healthcare & Institutional Property – Other
- Recreational Place: Variable Use
- Sport, Health Club
- Manufacture: Paint, Drug, Asphalt, Petroleum, Plastics, Chemicals
- House
- Community Hall
- Church, Place of Worship
- Furniture, Furnishing, Appliance, Sales, Repairs
- General Storage
- Communication and Data Processing
- Residential Property – not classified above
- Laboratory
- Road, Street
- Power Station, Energy Production
- Manufacture: Mineral Products
- Utilities and Energy Distribution
- Storage: Food, Beverage, Hay, Crops
- Not Recorded
- Studio, Radio, Film Production
- School: Residential and Boarding
- Storage: Paint, Drug, Asphalt, Chemical, Plastic
- Rubbish Tip, Transfer Station
- Storage: Textile, Leather, Rubber
- Storage: Metal, Metal Products, Machinery and Electrical
- Storage: Mineral Product
- Primary Industries & Utilities Property – other
- Storage: Wood and Paper
- Education Property – not classified above
- Mobile Property Storage and Parking
- School: Miscellaneous Educational Property

- Storage Property – not classified above
- Vehicle, Boat, Sales Service
- Manufacture: Clothing, Footwear, Luggage
- Manufacturing Property – not classified above
- Manufacture: Vehicle, Bicycle, Boat, Aircraft, Rail
- Special Structures
- Care of the Young
- Care of the Physically Disabled
- Residential Outbuilding, Shed, Garage
- Aircraft Area
- Storage: Petroleum Products
- Forest

- **Specific property use name**
  - Bank, Post bank
  - Rest home: With nursing care
  - Hotel, Motel, Lodge: Without liquor licence
  - General hospital: Public and private
  - Airport terminal
  - Manufacture: Machinery, Engines, Parts
  - Flats, Apartments, Units 11 to 20
  - Office: General business
  - Police station: With cells
  - Commercial Property – not classified above
  - University lecture room, Medical, Dental or Vet school
  - Flats, Apartments, Units over 40
  - Flats, Apartments, Units 1 to 2
  - Hotel, Motel, Lodge: With liquor licence
  - Museum, Art gallery, Planetarium
  - Slaughter, Meat works, Meat prep, Meat preserving
  - Dry cleaner
  - Flats, Apartments, Units 21 to 30
  - Courtroom
  - Restaurant, Cafeteria, Diner
  - Tannery
  - Flats, Apartments, Units 3 to 10
  - Shopping mall
  - Commercial laundry
  - Bread, Bakery products, Biscuits, Pies etc
  - Flats, Apartments, Units 31 to 40
  - Department store
  - Accident and emergency clinic
  - Boarding, Half-way house, Dormitory – Other
  - Unable to classify
  - University/School accommodation or Dormitory
  - Milk, Ice cream, Cheese, Butter, Dairy products
  - Takeaway bar, Lunch bar, Fish and chips, Fast food
  - Cinema, Picture theatre
  - Pub, Tavern, Inn
  - Clothing shop: New and used
  - Boarding house
  - Kitset, Modular, Prefab. Buildings

- Half-way house
- Office, Commercial premises – not classified above
- High school, College
- Building under construction
- Polytech, Nursing, Agricultural, Vocational school
- Manufacture: Electrical or electronic Equip/Batteries
- Hardware shop
- Supermarket: Over 1000 m_2
- Psychiatric institution
- Healthcare & Institutional Property – Other
- Grandstand, Stadium, Sportsfield
- Sports clubroom: Rugby, Athletics, Boating, YMCA etc
- Rest home: Without nursing care
- Supplies and services – not classified above
- Manufacture: Other industrial chemicals(hazardous)
- Single house
- Military forces, Police barracks
- Community hall, Scout hall, Girl Guide hall
- Manufacture: Rubber, Rubber products
- Church hall, Whare karakia
- Furniture, Appliance, Sales, Repairs – Other
- Mixed goods storage, Warehouse
- Church, Chapel, Synagogue, Mission
- Telephone exchange
- Indoor sports centre
- Residential Property – not classified above
- Historic building
- Library
- Laboratory: Electrical, Electronic
- Business or Language school, other specialty school
- Public road, Street, Footpath
- Power station: Gas, Diesel
- Gymnasium, Ballroom, Dance hall
- Manufacture: Furniture, Bedding
- Freight terminal, Freight forwarding, Wharf shed
- Supermarket: Under 1000 m_2, Superette, Market
- Building under renovation
- Embassy, Consulate
- Manufacture: Box, Crate, Carton, Barrel, Basket
- Manufacture: Glass products, Optical , Fibreglass
- Manufacture: Other metals (raw products)
- Sportsclub with restaurant
- Manufacture: Paper, Pulp, Cardboard
- Sub-station, Transformers, Power lines
- Veterinary clinic
- Laboratory: Materials testing
- Storage: Grain elevators
- Not Recorded
- Hairdresser, Beauty salon, Barbers shop
- Manufacture: Metal products or processes, Galvanising, Welding
- Milling: Flour, Grain, Rice, Cereals
- Printing, Typesetting, Photoengraving, Engraving

- Furniture shop: New and used
- Primary school
- Recreation places: Fixed use – Other
- Manufacture: Plastic raw materials
- Film production studio
- Community or Occupational Health, Physiotherapy
- School classroom building – Any Year 1 – 13
- Prison: Men's
- Other shop – not classified above
- Storage: Bagged, Baled, Boxed, Packaged, Other
- Storage: Explosives
- Area school: Combination of years 1 – 13
- Day care centre, Playcentre, Creche
- Massage parlour, Strip club
- Laboratory: Medical, Chemical, Biological
- Rubbish transfer station
- Laundromat
- Vacant building
- Storage open: Barn, Silo, Bin, Bulk/loose
- Young persons' detention, Borstal
- Hospice
- Community Care e.g. IHC institution or similar
- Storage: Clothing, Finished textiles
- Manufacture: Plastic finished products
- Storage: Metal parts, Construction, Auto, Plumbing, Mesh
- Storage: Cement
- Fire station, Ambulance station
- Prison: Womens
- Live theatre
- Primary Industries & Utilities Property – other
- Nurses home
- Auditorium, Concert hall
- Storage: Recycled paper
- Appliances, Electronic goods
- Swimming pool, Spa pool
- Trade supply
- Education Property – not classified above
- Pet shop
- Rubbish tip, Transfer station – Other
- Billiard, Pool centre
- Doctors, Dental, Physio, or other medical centre
- Private fleet carpark: Car, Bus, Truck (1 level – covered)
- Wharenui – Cultural meeting house
- Exhibition hall
- Car wrecker, Scrapyard
- School for the blind, School for the deaf
- Intermediate/high school classroom building
- Storage: Asphalt, Tar, Coal, Briquettes etc
- Data processing centre
- Storage Property – not classified above
- Nightclub
- Primary/intermediate classroom building

- Vehicle/Motorcycle/Trailer sales, Farm machinery
- Manufacture: Natural Materials, Wool, Cotton, Silk
- Storage: Frozen food, Freezer
- Recreation places: Variable use – Other
- Sawmill, Wood components, Tanalising, Prefab parts
- Manufacture: Footwear
- Manufacture: Paint, Varnish, Inks, Wax, Adhesive
- Manufacturing Property – not classified above
- Manufacture: Textile, Leather, Rubber – other
- Storage: Paper products, Cartons, Bags
- Structure under renovation
- Kindergarten, Pre-school centre, Te Kohanga Reo
- Storage, Warehousing: Mixed foodstuffs
- Intermediate school
- Video games, Housie, Amusement centre
- Manufacture/Repair: Boats <20m Parts, Engine, Drydock
- School: Trade, Business – not classified above
- Dairy, Butcher, Fish shop, Bakery, Other food shop
- Laboratory: Educational, Psychological
- Public toilet
- Children's health camp
- Shoe shop
- Manufacture: Concrete materials, blocks, tiles
- Potato chips, Snack foods etc
- Manufacture: Asphalt, Tar, Coal, Briquettes etc
- Drug, Alcohol, Substance abuse rehab centre
- Sugar refining, Syrups, Chocolate, Cocoa, Lollies
- Canning, Packaging, Preserving or Dehydrating Food/Juice
- Children's home, Orphanage
- Book, Magazine, Stationery, Office supplies
- Storage: Plastic, Plastic product
- Manufacture/Repair: Boats>20m Parts, Engines, Drydock
- Manufacture: Synthetic Fabrics, Nylon, Rugs, Other
- Physical rehabilitation facility
- Aircraft hangar
- Storage: Canned, Bottled
- Tailor, Dressmaker
- Laboratory: Agricultural
- Public carpark: Multi-storied above ground
- Playground, Park, Amusement park
- Police station: No cells, Periodic detention centre
- Baking powder, Yeast, Vinegar, Spices, Tea, Salt
- Gifts, Souvenirs
- Foster home
- Garage
- Manufacture: Industrial chemicals & gases (non-haz)
- Ten pin bowling alley
- Optician
- Radio, TV studio
- Professional supply, Instruments, Equipment
- Storage: Raw metal product
- Taxiway, Loading/Parking area, Maintenance area

- Hotel supply, Restaurant, Hospitality goods
- Manufacture: Drug, Medicine, Cosmetic, Perfume
- Mechanical repair, Auto-electrician, Paint & Panel
- Runway
- Funeral home/parlour
- Cool store
- Railway station
- Storage: LPG
- Motorway
- Mixed
- Food and beverage sales – not classified above
- Hazardous waste disposal
- Storage: Bulk flammable liquids
- Service station: Public
- Dog kennel, Aviary, Cage, Other animal enclosures
- Storage: Paint, Varnish, Ink, Wax, Adhesive
- Food and beverage sales – unknown or undetermined
- Manufacture: Book, Newspaper, Magazine, Journal
- Manufacture: Iron, Steel (raw products)
- Utilities and energy distribution – Other
- Canning, Packaging, Preserving: Fish, Seafood

- **Prior actions 1 name**

  - Information not recorded
  - Removal of hazard
  - No action taken by Civilian/Occupant/Passerby
  - Isolating power source
  - Portable extinguisher (all types)
  - Bucket/Container of water, bucket pump
  - Action prior – not classified above
  - Isolating fuel supply
  - Unable to classify
  - Fixed fire-hose reel
  - Rescue performed to save life
  - Garden hose

- **Actions taken name**

  - Extinguishment and ventilation
  - Investigation only (Fire related)
  - Extinguishment only: Includes isolating fuel/power
  - Ventilation only
  - Extinguishment, salvage and ventilation
  - Monitor only (Fire related)
  - Fire related – not classified above
  - Medical/First Aid Assistance
  - Salvage only
  - Investigation Only (Non-Fire related)
  - Isolating Power or Fuel Supply
  - Water removal: Sprinkler operated
  - Extrication
  - No Action Required – Includes appliance stood down

- Water removal: Domestic, commercial, weather related floods
- Miscellaneous, no action – not classified above
- Referred to proper authority
- Isolating/Removal of Power Supply
- Haz substance involved in fire, made safe
- Haz substance involved in fire, made safe & salvage
- Monitor only (Non fire related)

- **Location of origin name**
  - Wall surface (exterior)
  - Lounge, Common room, TV room, Music room
  - Stairs (interior)
  - Manufacturing, Process, Work room
  - Kitchen, Cooking area
  - Machinery Room/Area: Engine, Cooling, Pump, Lift
  - Technical, Manufacturing area – Other
  - Toilet, Locker room, Rest room, Bathroom, Sauna
  - Hallway, Passageway, Corridor, Walkway in mall
  - Small assembly area: Classroom, Meeting room, etc
  - Office
  - Service or equipment area – not classified above
  - Garage, Carport, Vehicle storage, Storage Shed
  - Bedroom, Sleeping area, Cell: under 5 persons
  - Supply area, Tool room, Maintenance supply room
  - Laundry area, Wash house
  - Chimney
  - Ceiling and roof assembly
  - Product storage, Tank, Bin, Agri storage, Hay
  - Transformer, Switch gear, Electrical control board
  - Lobby, Entrance way
  - Record storage/room, Vault
  - Living area – not classified above
  - Patio, Court, Terrace, Gazebo
  - Computer/Electronic Equip Control Room/Area
  - Area under construction or major renovation
  - Showroom, Sales area
  - Library, Art gallery, Exhibition space
  - Shipping area, Receiving/Loading/Packing area
  - Dining area, Cafeteria, Canteen, Servery, Bar area
  - Lift, Dumbwaiter
  - Large assembly area: Auditorium, Church, Lecture Hall etc
  - Unable to classify
  - Wardrobe, Cupboard, Walk in pantry
  - Recreational: Swimming pool, Gym, Massage, Sauna
  - Chute: Mail, Laundry (not Rubbish)
  - Duct: Air, Heating, Cable, Exhaust
  - Ventilation shaft, Conduit shaft, Utility shaft
  - Wall assembly: Concealed wall space
  - Laboratory
  - Ceiling and floor assembly
  - Rubbish, Industrial waste, Waste container
  - Outside area, multiple area – not classified above

- Engine area, Running gear
- Not Recorded
- Bedroom, Sleeping area, Cell: 5 or more persons
- Large open room: Ballroom, Gym, Rink, Bowling etc
- Balcony, Porch, Veranda
- Heating equipment, Water heating
- Light well
- Maintenance shop, Repair, Welding, Spray Painting
- First aid, Surgery, Treatment room, Dialysis room
- Stairs (exterior): Fire escape, Ramp
- Operating theatre, Recovery room
- Storage and garage area – not classified above
- Stage area, Dressing room, Performance area
- Conveyer
- Road, Street, Parking lot, Highway, Motorway
- Roof surface (exterior)
- Crawl space, Basement
- Multiple areas of origin

- **Fire cause name**
  - Unlawful
  - Careless disposal or use: cigarettes, ashes, embers
  - Heat source too close to combustibles
  - Operating deficiency – not classified above
  - Unattended cooking
  - Other electrical failure
  - Part failure, leak or break
  - Falling asleep smoking
  - Automatic control failure
  - Carelessness with heat source – Other
  - Short circuit, earth fault
  - Mechanical failure, malfunction – Other
  - Spontaneous ignition
  - Equipment unattended
  - Design deficiency
  - Lack of maintenance
  - Installation deficiency
  - Installed too close to combustibles
  - Improper startup or shut down procedures
  - Suspicious
  - People impaired by drugs or alcohol
  - Improper storage procedures
  - Flammable liquid/gas accidentally spilled/released
  - Failure to use ordinary care
  - Failure to clean
  - Accidentally turned on: not turned off
  - Design, construction or installation fault – Other
  - Equipment not being operated properly
  - Equipment overloaded
  - Unable to classify
  - Combustible placed too close to heat source
  - Carelessness with material ignited – other

- Undetermined
- Reckless act (involving fire)
- Animal
- Thawing
- Friction (sparks etc.)
- Earthquake
- Construction deficiency
- Lawful
- Collision, overturn, knockdown
- Manual control failure
- Solar, sun
- High temperature
- People otherwise impaired: unconscious, mental/physical
- Poor Workmanship
- Reckless with fireworks
- Rekindled from previous fire, Re-ignition
- Improper fuelling technique: vehicle, saws, motors
- Equipment used for purpose not intended
- Inadequate control: open fires/campfires/bonfires
- People playing with heat sources
- Legality not known
- High wind
- Lightning
- Deliberately lit fire – not classified above
- People playing with combustibles
- No spark arrester or it was improperly installed
- Improper container
- Pyrophoric
- Reckless (involving fire) – not classified above
- Exposure fire
- Flammable liquid used: Kindle fire/cleaning/painting
- Extreme conditions – not classified above
- Backfire
- High water, floods
- Information not recorded

- **Flame damage name**
  - Not Recorded
  - Confined to part of room or area of origin
  - Confined to room of origin
  - Confined to object of origin
  - No damage of this type
  - Confined to fire cell of origin
  - Confined to floor of origin
  - Confined to structure of origin
  - Extended beyond structure of origin

- **Smoke damage name**
  - Not Recorded
  - Confined to part of room or area of origin
  - Confined to room of origin

- No damage of this type
- Confined to object of origin
- Confined to structure of origin
- Confined to fire cell of origin
- Confined to floor of origin
- Extended beyond structure of origin

- **Water damage name**
  - Not Recorded
  - Confined to structure of origin
  - Confined to room of origin
  - Confined to part of room or area of origin
  - No damage of this type
  - Confined to fire cell of origin
  - Confined to object of origin
  - Confined to floor of origin
  - Extended beyond structure of origin
- **Control damage name**
  - Not Recorded
  - No damage of this type
  - Confined to part of room or area of origin
  - Confined to room of origin
  - Confined to object of origin
  - Confined to floor of origin
  - Confined to structure of origin
  - Confined to fire cell of origin
  - Extended beyond structure of origin
- **Percent of property saved name**
  - Ten percentage increments from 0% to 100%
- **Avenue of flame travel name**
  - Not Recorded
  - Wall covering
  - Stored material
  - No travel
  - Non enclosed stairwell, lift shaft
  - Door open
  - Structural factor allowing vertical travel – not classified above
  - Inadequate fire stopping
  - Air handling ducts
  - Combination of any of: ceiling, wall, floor finish
  - Exterior spread
  - Interior window failure
  - Gravity (fell on)
  - Ceiling covering
  - Furniture, fixtures
  - Failure of rated assembly
  - Floor covering

- Attic space, ceiling, concealed space
- Unable to classify
- Service shaft, pipe shaft
- Corridor, Excessive open area
- Flammable liquid
- Pre-existing opening not a wall or door
- Conveyer (includes special materials)
- Wall burned through
- Decorations
- Human being, animal
- Unknown
- Air handling duct
- Wind
- Floor, ceiling failure
- Pipeline, material transfer system
- Flammable dust, solid chemical

- **Avenue of smoke travel name**
  - Not Recorded
  - Unable to classify
  - Wall covering
  - Stored material
  - Combination of any of: ceiling, wall, floor finish
  - No travel
  - Inadequate fire stopping
  - Non enclosed stairwell, lift shaft
  - Door open
  - Air handling ducts
  - Exterior spread
  - Wind
  - Furniture, fixtures
  - Ceiling covering
  - Corridor, Excessive open area
  - Pre-existing opening not a wall or door
  - Structural factor allowing vertical travel – not classified above
  - Service shaft, pipe shaft
  - Failure of rated assembly
  - Attic space, ceiling, concealed space
  - Conveyer (includes special materials)
  - Air handling duct
  - Wall burned through
  - Gravity (fell on)
  - Floor covering
  - Pipeline, material transfer system
  - Interior window failure
  - Unknown
  - Flammable liquid
  - Flammable dust, solid chemical
  - Floor, ceiling failure
  - Human being, animal

- **Area structure**

- Numerical

- **Total area of structure**
  - Numerical
- **Year constructed name**
  - Not Recorded
  - 1900–1945
  - 1970–1991
  - 1992–2005
  - 1946–1969
  - Pre 1900
  - 2006 onwards
  - Unknown
- **Construction type name**
  - Not Recorded
  - Reinforced concrete with non-combustible cladding
  - Metal frame unprotected
  - Brick, Blocks etc
  - Reinforced concrete tilt slab
  - Timber frame unprotected (normal housing)
  - Metal frame protected
  - Reinforced concrete with combustible cladding
  - Timber frame protected
  - Unable to classify
  - Unknown
  - Plastic Construction: composite formed
  - Polystyrene Blocks
- **Number of floors**
  - Numerical
- **Civilians rescued**
  - Numerical
- **Civilians extricated**
  - Numerical
- **Civilians assisted**
  - Numerical

Appendix B: Incident data for "civilians assisted" fires

Fire record:	1			
Incident Type:	Structure fire with damage		Civilians assisted:	10
Alarm level:	1		Prior actions:	Information not recorded
Arrival condition:	Small fire		Action taken:	Extinguishment, salvage and ventilation
Fire detector type:	Smoke Detector System (Monitored)		Location of origin:	Wall surface (exterior)
Sprinklers activated:	0		Control damage:	Confined to part of room or area of origin
Detector Performance:	System operated AND was EFFECTIVE		Flame damage:	Confined to fire cell of origin
General property use:	Residential		Smoke damage:	Confined to structure of origin
Specific property use name:	Flats, Apartments, Units 21 to 30		Avenue of smoke travel:	Non enclosed stairwell, lift shaft
Number of floors:	5		Avenue of flame travel:	Non enclosed stairwell, lift shaft
iCAD information summary:				
small fire, residents from apartment 21 evacuated to roof due to smoke logging in foyer, apartment 19 unable to evacuate due to smoke logging				

Fire record:	2			
Incident Type:	Structure fire with damage		Civilians assisted:	1
Alarm level:	1		Prior actions:	Bucket/Container of water, bucket pump
Arrival condition:	Smoke only		Action taken:	Ventilation only
Fire detector type:	Smoke Detector System (Monitored)		Location of origin:	Ceiling and roof assembly
Sprinklers activated:	0		Control damage:	No damage of this type
Detector Performance:	System operated AND was EFFECTIVE		Flame damage:	Confined to part of room or area of origin
General property use:	Commercial, Retail, Manufacturing, Storage		Smoke damage:	Confined to part of room or area of origin
Specific property use name:	Commercial Property - not classified above		Avenue of smoke travel:	Ceiling covering
Number of floors:	4		Avenue of flame travel:	Ceiling covering
iCAD information summary:				
light bulb on fire - patient overcome by fumes				

Fire record:	3			
Incident Type:	Structure fire with damage		Civilians assisted:	6
Alarm level:	2		Prior actions:	Portable extinguisher (all types)
Arrival condition:	Out on arrival		Action taken:	Extinguishment, salvage and ventilation
Fire detector type:	Smoke Detector System (Monitored)		Location of origin:	Supply area, Tool room, Maintenance supply room
Sprinklers activated:	0		Control damage:	No damage of this type
Detector Performance:	System operated AND was EFFECTIVE		Flame damage:	Confined to object of origin
General property use:	Residential		Smoke damage:	No damage of this type
Specific property use name:	Hotel, Motel, Lodge: With liquor licence		Avenue of smoke travel:	No travel
Number of floors:	5		Avenue of flame travel:	No travel
iCAD information summary:				
2nd alarm electrical fire, 4th floor, 2 status 3 patients removed to hospital, six security staff involved with fire extinguishment				

Fire record:	4			
Incident Type:	Structure fire with damage		Civilians assisted:	2
Alarm level:	2		Prior actions:	No action taken by Civilian/Occupant/Passerby
Arrival condition:	Small fire		Action taken:	Extinguishment, salvage and ventilation
Fire detector type:	Heat detector, Thermal detector		Location of origin:	Laundry area, Wash house
Sprinklers activated:	1		Control damage:	Confined to structure of origin
Detector Performance:	System operated AND was EFFECTIVE		Flame damage:	Confined to fire cell of origin
General property use:	Residential		Smoke damage:	Confined to fire cell of origin
Specific property use name:	Flats, Apartments, Units 11 to 20		Avenue of smoke travel:	Door open
Number of floors:	3		Avenue of flame travel:	Combination of any of: ceiling, wall, floor finish
iCAD information summary:				
fire in back bedroom, 1st floor, residents unable to get out smoke in hallways, flat number 9, panicked calls from neighbours above due to smoke				

Fire record:	5			
Incident Type:	Structure fire with damage		Civilians assisted:	2
Alarm level:	1		Prior actions:	No action taken by Civilian/Occupant/Passerby
Arrival condition:	Smoke only		Action taken:	Extinguishment only: Includes isolating fuel/power
Fire detector type:	Sprinkler		Location of origin:	Kitchen, Cooking area
Sprinklers activated:	1		Control damage:	Confined to part of room or area of origin
Detector Performance:	System operated AND was EFFECTIVE		Flame damage:	Confined to part of room or area of origin
General property use:	Residential		Smoke damage:	Confined to floor of origin
Specific property use name:	Flats, Apartments, Units over 40		Avenue of smoke travel:	Combination of any of: ceiling, wall, floor finish
Number of floors:	30		Avenue of flame travel:	Wall covering
iCAD information summary:				
sprinkler gong sounding, kitchen fire extinguished by sprinkler				

Fire record:	**6**		
Incident Type:	Structure fire with damage	**Civilians assisted:**	10
Alarm level:	2	**Prior actions:**	No action taken by Civilian/Occupant/Passerby
Arrival condition:	Small fire	**Action taken:**	Extinguishment, salvage and ventilation
Fire detector type:	Sprinkler	**Location of origin:**	Kitchen, Cooking area
Sprinklers activated:	1	**Control damage:**	Confined to part of room or area of origin
Detector Performance:	System operated AND was EFFECTIVE	**Flame damage:**	Confined to part of room or area of origin
General property use:	Residential	**Smoke damage:**	Confined to room of origin
Specific property use name:	Flats, Apartments, Units over 40	**Avenue of smoke travel:**	Combination of any of: ceiling, wall, floor finish
Number of floors:	10	**Avenue of flame travel:**	Wall covering
iCAD information summary:			
apartment fire, 2nd floor, sprinkler activated			

Fire record:	**7**		
Incident Type:	Structure fire with damage	**Civilians assisted:**	1
Alarm level:	1	**Prior actions:**	Information not recorded
Arrival condition:	Small fire	**Action taken:**	Extinguishment and ventilation
Fire detector type:	Smoke Detector System (Monitored)	**Location of origin:**	Transformer, Switch gear, Electrical control board
Sprinklers activated:	0	**Control damage:**	No damage of this type
Detector Performance:	rted occupants but detector not in room of origin	**Flame damage:**	Confined to part of room or area of origin
General property use:	Commercial, Retail, Manufacturing, Storage	**Smoke damage:**	Confined to part of room or area of origin
Specific property use name:	Office: General business	**Avenue of smoke travel:**	Service shaft, pipe shaft
Number of floors:	7	**Avenue of flame travel:**	Service shaft, pipe shaft
iCAD information summary:			
switchboard fire 2nd level, extinguishers			

Fire record:	**8**		
Incident Type:	Structure fire with damage	**Civilians assisted:**	1
Alarm level:	2	**Prior actions:**	Bucket/Container of water, bucket pump
Arrival condition:	Out on arrival	**Action taken:**	Extinguishment, salvage and ventilation
Fire detector type:	Sprinkler	**Location of origin:**	Kitchen, Cooking area
Sprinklers activated:	1	**Control damage:**	Confined to room of origin
Detector Performance:	Detector in Room operated AND was EFFECTIVE	**Flame damage:**	Confined to object of origin
General property use:	Residential	**Smoke damage:**	Confined to part of room or area of origin
Specific property use name:	Flats, Apartments, Units over 40	**Avenue of smoke travel:**	Door open
Number of floors:	19	**Avenue of flame travel:**	No travel
iCAD information summary:			
furniture on fire level 14, sprinkler gong going, stove top fire, 1 person with slight burns to hands			

Fire record:	**9**		
Incident Type:	Structure fire with damage	**Civilians assisted:**	2
Alarm level:	1	**Prior actions:**	No action taken by Civilian/Occupant/Passerby
Arrival condition:	Small fire	**Action taken:**	Extinguishment, salvage and ventilation
Fire detector type:	Sprinkler	**Location of origin:**	Kitchen, Cooking area
Sprinklers activated:	1	**Control damage:**	Confined to part of room or area of origin
Detector Performance:	Detector in room of origin - not classified above	**Flame damage:**	Confined to part of room or area of origin
General property use:	Residential	**Smoke damage:**	Confined to fire cell of origin
Specific property use name:	Flats, Apartments, Units over 40	**Avenue of smoke travel:**	Door open
Number of floors:	13	**Avenue of flame travel:**	Wall covering
iCAD information summary:			
fire on ground floor, sprinkler gong going, uni accommodation			

Fire record:	**10**		
Incident Type:	Structure fire with damage	**Civilians assisted:**	5
Alarm level:	1	**Prior actions:**	Portable extinguisher (all types)
Arrival condition:	Smoke only	**Action taken:**	Fire related - not classified above
Fire detector type:	Smoke Detector System (Monitored)	**Location of origin:**	Machinery Room/Area: Engine, Cooling, Pump, Lift
Sprinklers activated:	0	**Control damage:**	No damage of this type
Detector Performance:	System operated AND was EFFECTIVE	**Flame damage:**	Confined to part of room or area of origin
General property use:	Commercial, Retail, Manufacturing, Storage	**Smoke damage:**	Confined to room of origin
Specific property use name:	Office: General business	**Avenue of smoke travel:**	No travel
Number of floors:	20	**Avenue of flame travel:**	Furniture, fixtures
iCAD information summary:			
female stuck in lift, see rescued list			

Fire record:	**11**			
Incident Type:	Structure fire with damage		**Civilians assisted:**	2
Alarm level:	1		**Prior actions:**	Isolating power source
Arrival condition:	Small fire		**Action taken:**	Extinguishment, salvage and ventilation
Fire detector type:	Smoke Detector System (Monitored)		**Location of origin:**	Kitchen, Cooking area
Sprinklers activated:	0		**Control damage:**	Confined to object of origin
Detector Performance:	tector Not in Room operated AND was EFFECTIVE		**Flame damage:**	Confined to part of room or area of origin
General property use:	Residential		**Smoke damage:**	Confined to fire cell of origin
Specific property use name:	Flats, Apartments, Units over 40		**Avenue of smoke travel:**	Service shaft, pipe shaft
Number of floors:	5		**Avenue of flame travel:**	Wall covering
iCAD information summary:				
fire involving wall, extending to rangehood				

Fire record:	**12**			
Incident Type:	Structure fire with damage		**Civilians assisted:**	4
Alarm level:	2		**Prior actions:**	Information not recorded
Arrival condition:	Small fire		**Action taken:**	Extinguishment, salvage and ventilation
Fire detector type:	Residential sprinkler		**Location of origin:**	Kitchen, Cooking area
Sprinklers activated:	1		**Control damage:**	Not Recorded
Detector Performance:	Alerted occupants - detector in room of origin		**Flame damage:**	Confined to part of room or area of origin
General property use:	Residential		**Smoke damage:**	Confined to fire cell of origin
Specific property use name:	Flats, Apartments, Units over 40		**Avenue of smoke travel:**	Not Recorded
Number of floors:	16		**Avenue of flame travel:**	Not Recorded
iCAD information summary:				
confirmed fire level 6, apartment, 1 elderly patient released from hospital, status 3 declining				

Fire record:	**13**			
Incident Type:	Structure fire with damage		**Civilians assisted:**	1
Alarm level:	3		**Prior actions:**	Information not recorded
Arrival condition:	Out on arrival		**Action taken:**	Ventilation only
Fire detector type:	Sprinkler		**Location of origin:**	Kitchen, Cooking area
Sprinklers activated:	1		**Control damage:**	Confined to structure of origin
Detector Performance:	System operated AND was EFFECTIVE		**Flame damage:**	Confined to part of room or area of origin
General property use:	Residential		**Smoke damage:**	Confined to room of origin
Specific property use name:	Flats, Apartments, Units over 40		**Avenue of smoke travel:**	Ceiling covering
Number of floors:	12		**Avenue of flame travel:**	Ceiling covering
iCAD information summary:				
fire reported on 11th floor, fire extinguished by sprinklers, occupant treated by ambulance for shock				

Fire record:	**14**			
Incident Type:	Structure fire with damage		**Civilians assisted:**	2
Alarm level:	1		**Prior actions:**	Information not recorded
Arrival condition:	Small fire		**Action taken:**	Extinguishment, salvage and ventilation
Fire detector type:	Smoke Detector System (Monitored)		**Location of origin:**	Ceiling and floor assembly
Sprinklers activated:	0		**Control damage:**	Not Recorded
Detector Performance:	Alerted occupants - detector in room of origin		**Flame damage:**	Confined to part of room or area of origin
General property use:	Residential		**Smoke damage:**	Confined to room of origin
Specific property use name:	Flats, Apartments, Units over 40		**Avenue of smoke travel:**	Not Recorded
Number of floors:	21		**Avenue of flame travel:**	Not Recorded
iCAD information summary:				
smoke logging level 10, fire in extractor fan and ducting in ceiling				

Fire record:	**15**			
Incident Type:	Structure fire with no damage		**Civilians assisted:**	1
Alarm level:	1		**Prior actions:**	Information not recorded
Arrival condition:	Smoke only		**Action taken:**	Ventilation only
Fire detector type:	Smoke Detector System (Monitored)		**Location of origin:**	Kitchen, Cooking area
Sprinklers activated:	0		**Control damage:**	Not Recorded
Detector Performance:	Alerted occupants - detector in room of origin		**Flame damage:**	Not Recorded
General property use:	Residential		**Smoke damage:**	Not Recorded
Specific property use name:	Flats, Apartments, Units 11 to 20		**Avenue of smoke travel:**	Not Recorded
Number of floors:	0		**Avenue of flame travel:**	Not Recorded
iCAD information summary:				
false alarm				

Fire record:	**16**		
Incident Type:	Structure fire with no damage	**Civilians assisted:**	3
Alarm level:	1	**Prior actions:**	No action taken by Civilian/Occupant/Passerby
Arrival condition:	Smoke only	**Action taken:**	Ventilation only
Fire detector type:	Smoke Detector System (Monitored)	**Location of origin:**	Kitchen, Cooking area
Sprinklers activated:	0	**Control damage:**	Not Recorded
Detector Performance:	rted occupants but detector not in room of origin	**Flame damage:**	Not Recorded
General property use:	Residential	**Smoke damage:**	Not Recorded
Specific property use name:	Hotel, Motel, Lodge: Without liquor licence	**Avenue of smoke travel:**	Not Recorded
Number of floors:	0	**Avenue of flame travel:**	Not Recorded
iCAD information summary:			

false alarm

Fire record:	**17**		
Incident Type:	Structure fire with no damage	**Civilians assisted:**	3
Alarm level:	2	**Prior actions:**	Information not recorded
Arrival condition:	Smoke only	**Action taken:**	Extinguishment, salvage and ventilation
Fire detector type:	Smoke Detector System (Monitored)	**Location of origin:**	Machinery Room/Area: Engine, Cooling, Pump, Lift
Sprinklers activated:	0	**Control damage:**	Not Recorded
Detector Performance:	System operated AND was EFFECTIVE	**Flame damage:**	Not Recorded
General property use:	Residential	**Smoke damage:**	Not Recorded
Specific property use name:	Flats, Apartments, Units 11 to 20	**Avenue of smoke travel:**	Not Recorded
Number of floors:	0	**Avenue of flame travel:**	Not Recorded
iCAD information summary:			

smell of smoke 4th floor

Fire record:	**18**		
Incident Type:	Structure fire with no damage	**Civilians assisted:**	1
Alarm level:	2	**Prior actions:**	No action taken by Civilian/Occupant/Passerby
Arrival condition:	Smoke only	**Action taken:**	Investigation only (Fire related)
Fire detector type:	Smoke Detector System (Monitored)	**Location of origin:**	Small assembly area: Classroom, Meeting room, etc
Sprinklers activated:	0	**Control damage:**	Not Recorded
Detector Performance:	Did not operate - detector in room of origin	**Flame damage:**	Not Recorded
General property use:	Educational	**Smoke damage:**	Not Recorded
Specific property use name:	olytech, Nursing, Agricultural, Vocational school	**Avenue of smoke travel:**	Not Recorded
Number of floors:	0	**Avenue of flame travel:**	Not Recorded
iCAD information summary:			

hazy smoke level 5, evac of wheelchair bound person level 6, smoke contained to 3 rooms on level 5

Fire record:	**19**		
Incident Type:	Structure fire with no damage	**Civilians assisted:**	1
Alarm level:	2	**Prior actions:**	Isolating power source
Arrival condition:	Small fire	**Action taken:**	Extinguishment and ventilation
Fire detector type:	Smoke Detector System (Monitored)	**Location of origin:**	Kitchen, Cooking area
Sprinklers activated:	0	**Control damage:**	Not Recorded
Detector Performance:	System operated AND was EFFECTIVE	**Flame damage:**	Not Recorded
General property use:	Residential	**Smoke damage:**	Not Recorded
Specific property use name:	Flats, Apartments, Units 21 to 30	**Avenue of smoke travel:**	Not Recorded
Number of floors:	0	**Avenue of flame travel:**	Not Recorded
iCAD information summary:			

smoke level 2 2nd alarm, disabled persons, fire located in apartment 2B

Fire record:	**20**		
Incident Type:	Structure fire with no damage	**Civilians assisted:**	1
Alarm level:	1	**Prior actions:**	Isolating power source
Arrival condition:	Smoke only	**Action taken:**	Investigation only (Fire related)
Fire detector type:	Smoke Detector System (Monitored)	**Location of origin:**	Kitchen, Cooking area
Sprinklers activated:	0	**Control damage:**	Not Recorded
Detector Performance:	Alerted occupants - detector in room of origin	**Flame damage:**	Not Recorded
General property use:	Residential	**Smoke damage:**	Not Recorded
Specific property use name:	Flats, Apartments, Units 31 to 40	**Avenue of smoke travel:**	Not Recorded
Number of floors:	0	**Avenue of flame travel:**	Not Recorded
iCAD information summary:			

smoke from cooking

Fire record:	**21**			
Incident Type:	Structure fire with no damage		**Civilians assisted:**	2
Alarm level:	1		**Prior actions:**	Information not recorded
Arrival condition:	Smoke only		**Action taken:**	Investigation only (Fire related)
Fire detector type:	Smoke Detector System (Monitored)		**Location of origin:**	Kitchen, Cooking area
Sprinklers activated:	0		**Control damage:**	Not Recorded
Detector Performance:	rted occupants but detector not in room of origin		**Flame damage:**	Not Recorded
General property use:	Residential		**Smoke damage:**	Not Recorded
Specific property use name:	Hotel, Motel, Lodge: With liquor licence		**Avenue of smoke travel:**	Not Recorded
Number of floors:	0		**Avenue of flame travel:**	Not Recorded
iCAD information summary:				
false alarm - smoke from burning butter in kitchen				

Fire record:	**22**			
Incident Type:	Structure fire with no damage		**Civilians assisted:**	1
Alarm level:	1		**Prior actions:**	Isolating power source
Arrival condition:	Smoke only		**Action taken:**	Ventilation only
Fire detector type:	Smoke Detector System (Monitored)		**Location of origin:**	Kitchen, Cooking area
Sprinklers activated:	0		**Control damage:**	Not Recorded
Detector Performance:	Alerted occupants - detector in room of origin		**Flame damage:**	Not Recorded
General property use:	Residential		**Smoke damage:**	Not Recorded
Specific property use name:	Flats, Apartments, Units over 40		**Avenue of smoke travel:**	Not Recorded
Number of floors:	0		**Avenue of flame travel:**	Not Recorded
iCAD information summary:				
false alarm - burnt cooking level 14				

Fire record:	**23**			
Incident Type:	Structure fire with no damage		**Civilians assisted:**	2
Alarm level:	1		**Prior actions:**	Isolating power source
Arrival condition:	No fire or smoke		**Action taken:**	Investigation only (Fire related)
Fire detector type:	Smoke Detector System (Monitored)		**Location of origin:**	Kitchen, Cooking area
Sprinklers activated:	0		**Control damage:**	Not Recorded
Detector Performance:	rted occupants but detector not in room of origin		**Flame damage:**	Not Recorded
General property use:	Residential		**Smoke damage:**	Not Recorded
Specific property use name:	Flats, Apartments, Units 31 to 40		**Avenue of smoke travel:**	Not Recorded
Number of floors:	0		**Avenue of flame travel:**	Not Recorded
iCAD information summary:				
fire in pot on stove				

Fire record:	**24**			
Incident Type:	Structure fire with no damage		**Civilians assisted:**	2
Alarm level:	1		**Prior actions:**	Information not recorded
Arrival condition:	No fire or smoke		**Action taken:**	Investigation only (Fire related)
Fire detector type:	Smoke Detector System (Monitored)		**Location of origin:**	Kitchen, Cooking area
Sprinklers activated:	0		**Control damage:**	Not Recorded
Detector Performance:	Detector in Room operated AND was EFFECTIVE		**Flame damage:**	Not Recorded
General property use:	Health, Institutional		**Smoke damage:**	Not Recorded
Specific property use name:	General hospital: Public and private		**Avenue of smoke travel:**	Not Recorded
Number of floors:	0		**Avenue of flame travel:**	Not Recorded
iCAD information summary:				
false alarm - sprinkler - hospital - burnt toast				

Fire record:	**25**			
Incident Type:	Structure fire with no damage		**Civilians assisted:**	1
Alarm level:	1		**Prior actions:**	Isolating power source
Arrival condition:	Out on arrival		**Action taken:**	Investigation only (Fire related)
Fire detector type:	Smoke Detector System (Monitored)		**Location of origin:**	Kitchen, Cooking area
Sprinklers activated:	0		**Control damage:**	Not Recorded
Detector Performance:	Alerted occupants - detector in room of origin		**Flame damage:**	Not Recorded
General property use:	Residential		**Smoke damage:**	Not Recorded
Specific property use name:	Flats, Apartments, Units 3 to 10		**Avenue of smoke travel:**	Not Recorded
Number of floors:	0		**Avenue of flame travel:**	Not Recorded
iCAD information summary:				
burnt toast - evacuation incomplete				

Fire record:	**26**			
Incident Type:	Structure fire with no damage		**Civilians assisted:**	20
Alarm level:	1		**Prior actions:**	No action taken by Civilian/Occupant/Passerby
Arrival condition:	Out on arrival		**Action taken:**	Extinguishment only: Includes isolating fuel/power
Fire detector type:	Smoke Detector System (Monitored)		**Location of origin:**	Hallway, Passageway, Corridor, Walkway in mall
Sprinklers activated:	0		**Control damage:**	Not Recorded
Detector Performance:	Alerted occupants - detector in room of origin		**Flame damage:**	Not Recorded
General property use:	Commercial, Retail, Manufacturing, Storage		**Smoke damage:**	Not Recorded
Specific property use name:	Office: General business		**Avenue of smoke travel:**	Not Recorded
Number of floors:	0		**Avenue of flame travel:**	Not Recorded
iCAD information summary:				
smell of burning - electrical?				

Fire record:	**27**			
Incident Type:	Structure fire with no damage		**Civilians assisted:**	1
Alarm level:	1		**Prior actions:**	Isolating power source
Arrival condition:	Smoke only		**Action taken:**	Ventilation only
Fire detector type:	Not Recorded		**Location of origin:**	Kitchen, Cooking area
Sprinklers activated:	0		**Control damage:**	Not Recorded
Detector Performance:	Not Recorded		**Flame damage:**	Not Recorded
General property use:	Commercial, Retail, Manufacturing, Storage		**Smoke damage:**	Not Recorded
Specific property use name:	Office: General business		**Avenue of smoke travel:**	Not Recorded
Number of floors:	0		**Avenue of flame travel:**	Not Recorded
iCAD information summary:				
false alarm				

Fire record:	**28**			
Incident Type:	Structure fire with no damage		**Civilians assisted:**	1
Alarm level:	1		**Prior actions:**	Bucket/Container of water, bucket pump
Arrival condition:	Smoke only		**Action taken:**	Extinguishment and ventilation
Fire detector type:	Smoke Detector System (Monitored)		**Location of origin:**	Bedroom, Sleeping area, Cell: under 5 persons
Sprinklers activated:	0		**Control damage:**	Not Recorded
Detector Performance:	Alerted occupants - detector in room of origin		**Flame damage:**	Not Recorded
General property use:	Residential		**Smoke damage:**	Not Recorded
Specific property use name:	Flats, Apartments, Units 1 to 2		**Avenue of smoke travel:**	Not Recorded
Number of floors:	0		**Avenue of flame travel:**	Not Recorded
iCAD information summary:				
ambulance - smoke inhalation -bedroom fire out on arrival				

Fire record:	**29**			
Incident Type:	Structure fire with no damage		**Civilians assisted:**	1
Alarm level:	1		**Prior actions:**	Removal of hazard
Arrival condition:	Smoke only		**Action taken:**	Extinguishment only: Includes isolating fuel/power
Fire detector type:	Smoke Detector System (Monitored)		**Location of origin:**	Kitchen, Cooking area
Sprinklers activated:	0		**Control damage:**	Not Recorded
Detector Performance:	rted occupants but detector not in room of origin		**Flame damage:**	Not Recorded
General property use:	Residential		**Smoke damage:**	Not Recorded
Specific property use name:	Hotel, Motel, Lodge: With liquor licence		**Avenue of smoke travel:**	Not Recorded
Number of floors:	0		**Avenue of flame travel:**	Not Recorded
iCAD information summary:				
food on fire in microwave - out on arrival				

Fire record:	**30**			
Incident Type:	Structure fire with no damage		**Civilians assisted:**	1
Alarm level:	1		**Prior actions:**	Isolating fuel supply
Arrival condition:	Smoke only		**Action taken:**	Extinguishment and ventilation
Fire detector type:	Smoke Detector System (Monitored)		**Location of origin:**	Kitchen, Cooking area
Sprinklers activated:	0		**Control damage:**	Not Recorded
Detector Performance:	Alerted occupants - detector in room of origin		**Flame damage:**	Not Recorded
General property use:	Residential		**Smoke damage:**	Not Recorded
Specific property use name:	Hotel, Motel, Lodge: Without liquor licence		**Avenue of smoke travel:**	Not Recorded
Number of floors:	0		**Avenue of flame travel:**	Not Recorded
iCAD information summary:				
smoke level B - female patient heart palpatations, fire on stove on 9th floor ext by occupant and firefighters				

Fire record:	**31**			
Incident Type:	Structure fire with no damage		**Civilians assisted:**	1
Alarm level:	1		**Prior actions:**	Portable extinguisher (all types)
Arrival condition:	Small fire		**Action taken:**	Extinguishment only: Includes isolating fuel/power
Fire detector type:	Smoke Detector System (Monitored)		**Location of origin:**	Hallway, Passageway, Corridor, Walkway in mall
Sprinklers activated:	0		**Control damage:**	Not Recorded
Detector Performance:	System operated AND was EFFECTIVE		**Flame damage:**	Not Recorded
General property use:	Commercial, Retail, Manufacturing, Storage		**Smoke damage:**	Not Recorded
Specific property use name:	Shopping mall		**Avenue of smoke travel:**	Not Recorded
Number of floors:	0		**Avenue of flame travel:**	Not Recorded
iCAD information summary:				
smoke detector 3rd floor - small fire out on arrival				

Fire record:	**32**			
Incident Type:	Structure fire with no damage		**Civilians assisted:**	1
Alarm level:	1		**Prior actions:**	Bucket/Container of water, bucket pump
Arrival condition:	Out on arrival		**Action taken:**	Ventilation only
Fire detector type:	Smoke Detector System (Monitored)		**Location of origin:**	Kitchen, Cooking area
Sprinklers activated:	0		**Control damage:**	Not Recorded
Detector Performance:	System operated AND was EFFECTIVE		**Flame damage:**	Not Recorded
General property use:	Residential		**Smoke damage:**	Not Recorded
Specific property use name:	Flats, Apartments, Units over 40		**Avenue of smoke travel:**	Not Recorded
Number of floors:	0		**Avenue of flame travel:**	Not Recorded
iCAD information summary:				
Pot on stove, out on arrival				

Fire record:	**33**			
Incident Type:	Structure fire with no damage		**Civilians assisted:**	3
Alarm level:	1		**Prior actions:**	Action prior - not classified above
Arrival condition:	Out on arrival		**Action taken:**	Salvage only
Fire detector type:	Sprinkler		**Location of origin:**	Kitchen, Cooking area
Sprinklers activated:	0		**Control damage:**	Not Recorded
Detector Performance:	System operated AND was EFFECTIVE		**Flame damage:**	Not Recorded
General property use:	Residential		**Smoke damage:**	Not Recorded
Specific property use name:	Flats, Apartments, Units 1 to 2		**Avenue of smoke travel:**	Not Recorded
Number of floors:	0		**Avenue of flame travel:**	Not Recorded
iCAD information summary:				
cooking fire - sprinkler activated				

Fire record:	**34**			
Incident Type:	Structure fire with no damage		**Civilians assisted:**	1
Alarm level:	1		**Prior actions:**	Information not recorded
Arrival condition:	Smoke only		**Action taken:**	Ventilation only
Fire detector type:	Smoke Detector System (Monitored)		**Location of origin:**	Kitchen, Cooking area
Sprinklers activated:	0		**Control damage:**	Not Recorded
Detector Performance:	System operated AND was EFFECTIVE		**Flame damage:**	Not Recorded
General property use:	Residential		**Smoke damage:**	Not Recorded
Specific property use name:	Flats, Apartments, Units 31 to 40		**Avenue of smoke travel:**	Not Recorded
Number of floors:	0		**Avenue of flame travel:**	Not Recorded
iCAD information summary:				
fire and smoke level 8, fire in oven OOA ventilation				

Fire record:	**35**			
Incident Type:	Structure fire with no damage		**Civilians assisted:**	1
Alarm level:	1		**Prior actions:**	Isolating power source
Arrival condition:	Out on arrival		**Action taken:**	Salvage only
Fire detector type:	Sprinkler		**Location of origin:**	Kitchen, Cooking area
Sprinklers activated:	0		**Control damage:**	Not Recorded
Detector Performance:	System operated AND was EFFECTIVE		**Flame damage:**	Not Recorded
General property use:	Residential		**Smoke damage:**	Not Recorded
Specific property use name:	Flats, Apartments, Units over 40		**Avenue of smoke travel:**	Not Recorded
Number of floors:	0		**Avenue of flame travel:**	Not Recorded
iCAD information summary:				
1 person with burns to hands				

Fire record:	**36**			
Incident Type:	Structure fire with no damage		**Civilians assisted:**	2
Alarm level:	1		**Prior actions:**	No action taken by Civilian/Occupant/Passerby
Arrival condition:	Out on arrival		**Action taken:**	Investigation only (Fire related)
Fire detector type:	Sprinkler		**Location of origin:**	Bedroom, Sleeping area, Cell: under 5 persons
Sprinklers activated:	0		**Control damage:**	Not Recorded
Detector Performance:	System operated AND was EFFECTIVE		**Flame damage:**	Not Recorded
General property use:	Health, Institutional		**Smoke damage:**	Not Recorded
Specific property use name:	Prison: Mens		**Avenue of smoke travel:**	Not Recorded
Number of floors:	0		**Avenue of flame travel:**	Not Recorded
iCAD information summary:				
small fire in cell				

Fire record:	**37**			
Incident Type:	Structure fire with no damage		**Civilians assisted:**	1
Alarm level:	1		**Prior actions:**	Bucket/Container of water, bucket pump
Arrival condition:	Out on arrival		**Action taken:**	Investigation only (Fire related)
Fire detector type:	Heat detector, Thermal detector		**Location of origin:**	Toilet, Locker room, Rest room, Bathroom, Sauna
Sprinklers activated:	0		**Control damage:**	Not Recorded
Detector Performance:	System operated AND was EFFECTIVE		**Flame damage:**	Not Recorded
General property use:	Residential		**Smoke damage:**	Not Recorded
Specific property use name:	Flats, Apartments, Units 21 to 30		**Avenue of smoke travel:**	Not Recorded
Number of floors:	0		**Avenue of flame travel:**	Not Recorded
iCAD information summary:				
attempted suicide, small fire in apartment OOA				

Fire record:	**38**			
Incident Type:	Structure fire with no damage		**Civilians assisted:**	1
Alarm level:	1		**Prior actions:**	Isolating power source
Arrival condition:	Smoke only		**Action taken:**	Investigation only (Fire related)
Fire detector type:	Smoke Detector System (Monitored)		**Location of origin:**	Hallway, Passageway, Corridor, Walkway in mall
Sprinklers activated:	0		**Control damage:**	Not Recorded
Detector Performance:	System operated AND was EFFECTIVE		**Flame damage:**	Not Recorded
General property use:	Recreational, Assembly		**Smoke damage:**	Not Recorded
Specific property use name:	Video games, Housie, Amusement centre		**Avenue of smoke travel:**	Not Recorded
Number of floors:	0		**Avenue of flame travel:**	Not Recorded
iCAD information summary:				
smell of electrical burning				

Fire record:	**39**			
Incident Type:	Structure fire with no damage		**Civilians assisted:**	1
Alarm level:	1		**Prior actions:**	Isolating power source
Arrival condition:	Smoke only		**Action taken:**	Extinguishment, salvage and ventilation
Fire detector type:	Smoke Detector System (Monitored)		**Location of origin:**	Machinery Room/Area: Engine, Cooling, Pump, Lift
Sprinklers activated:	0		**Control damage:**	Not Recorded
Detector Performance:	rted occupants but detector not in room of origin		**Flame damage:**	Not Recorded
General property use:	Commercial, Retail, Manufacturing, Storage		**Smoke damage:**	Not Recorded
Specific property use name:	Office: General business		**Avenue of smoke travel:**	Not Recorded
Number of floors:	0		**Avenue of flame travel:**	Not Recorded
iCAD information summary:				
fire in aircon unit				

Fire record:	**40**			
Incident Type:	Structure fire with no damage		**Civilians assisted:**	1
Alarm level:	1		**Prior actions:**	Removal of hazard
Arrival condition:	Out on arrival		**Action taken:**	Investigation only (Fire related)
Fire detector type:	Smoke Detector System (Monitored)		**Location of origin:**	Kitchen, Cooking area
Sprinklers activated:	0		**Control damage:**	Not Recorded
Detector Performance:	rted occupants but detector not in room of origin		**Flame damage:**	Not Recorded
General property use:	Residential		**Smoke damage:**	Not Recorded
Specific property use name:	Flats, Apartments, Units 31 to 40		**Avenue of smoke travel:**	Not Recorded
Number of floors:	0		**Avenue of flame travel:**	Not Recorded
iCAD information summary:				
kitchen appliance left on stove top, left with occupant in apartment				

Fire record:	**41**			
Incident Type:	Structure fire with no damage		**Civilians assisted:**	1
Alarm level:	1		**Prior actions:**	Information not recorded
Arrival condition:	Smoke only		**Action taken:**	Extinguishment and ventilation
Fire detector type:	Smoke Detector System (Monitored)		**Location of origin:**	Hallway, Passageway, Corridor, Walkway in mall
Sprinklers activated:	0		**Control damage:**	Not Recorded
Detector Performance:	Did not operate - detector not in room of origin		**Flame damage:**	Not Recorded
General property use:	Residential		**Smoke damage:**	Not Recorded
Specific property use name:	Boarding, Half-way house, Dormitory - Other		**Avenue of smoke travel:**	Not Recorded
Number of floors:	0		**Avenue of flame travel:**	Not Recorded
iCAD information summary:				
backpackers, electrical fire in door mechanism				

Fire record:	**42**			
Incident Type:	Structure fire with no damage		**Civilians assisted:**	1
Alarm level:	1		**Prior actions:**	Isolating power source
Arrival condition:	Out on arrival		**Action taken:**	Investigation only (Fire related)
Fire detector type:	Smoke Detector System (Monitored)		**Location of origin:**	Kitchen, Cooking area
Sprinklers activated:	0		**Control damage:**	Not Recorded
Detector Performance:	Detector in Room operated AND was EFFECTIVE		**Flame damage:**	Not Recorded
General property use:	Residential		**Smoke damage:**	Not Recorded
Specific property use name:	Flats, Apartments, Units over 40		**Avenue of smoke travel:**	Not Recorded
Number of floors:	0		**Avenue of flame travel:**	Not Recorded
iCAD information summary:				
false alarm, cooking				

Fire record:	**43**			
Incident Type:	Structure fire with no damage		**Civilians assisted:**	1
Alarm level:	1		**Prior actions:**	Information not recorded
Arrival condition:	Out on arrival		**Action taken:**	Investigation only (Fire related)
Fire detector type:	Smoke Detector System (Monitored)		**Location of origin:**	Kitchen, Cooking area
Sprinklers activated:	0		**Control damage:**	Not Recorded
Detector Performance:	Alerted occupants - detector in room of origin		**Flame damage:**	Not Recorded
General property use:	Residential		**Smoke damage:**	Not Recorded
Specific property use name:	Hotel, Motel, Lodge: Without liquor licence		**Avenue of smoke travel:**	Not Recorded
Number of floors:	0		**Avenue of flame travel:**	Not Recorded
iCAD information summary:				
small fire on stove top, OOA, ventilation				

Fire record:	**44**			
Incident Type:	Structure fire with no damage		**Civilians assisted:**	1
Alarm level:	1		**Prior actions:**	Information not recorded
Arrival condition:	No fire or smoke		**Action taken:**	Extinguishment only: Includes isolating fuel/power
Fire detector type:	Smoke Detector System (Monitored)		**Location of origin:**	Crawl space, Basement
Sprinklers activated:	0		**Control damage:**	Not Recorded
Detector Performance:	Detector in Room operated AND was EFFECTIVE		**Flame damage:**	Not Recorded
General property use:	Commercial, Retail, Manufacturing, Storage		**Smoke damage:**	Not Recorded
Specific property use name:	Pub, Tavern, Inn		**Avenue of smoke travel:**	Not Recorded
Number of floors:	0		**Avenue of flame travel:**	Not Recorded
iCAD information summary:				
overheated towels in dryer causing smoke				

Fire record:	**45**			
Incident Type:	Structure fire with no damage		**Civilians assisted:**	2
Alarm level:	1		**Prior actions:**	Portable extinguisher (all types)
Arrival condition:	Small fire		**Action taken:**	Extinguishment and ventilation
Fire detector type:	Smoke Detector System (Monitored)		**Location of origin:**	Laundry area, Wash house
Sprinklers activated:	0		**Control damage:**	Not Recorded
Detector Performance:	Detector not in room of origin - Other		**Flame damage:**	Not Recorded
General property use:	Residential		**Smoke damage:**	Not Recorded
Specific property use name:	Boarding, Half-way house, Dormitory - Other		**Avenue of smoke travel:**	Not Recorded
Number of floors:	0		**Avenue of flame travel:**	Not Recorded
iCAD information summary:				
backpackers, one person burns to hands and smoke inhalation, fire in laundry on first floor, 2 patients smoke inhalation, 1 patient with burns				

Fire record:	**46**		
Incident Type:	Structure fire with no damage	**Civilians assisted:**	2
Alarm level:	3	**Prior actions:**	Information not recorded
Arrival condition:	Small fire	**Action taken:**	Extinguishment, salvage and ventilation
Fire detector type:	Smoke Detector System (Monitored)	**Location of origin:**	Toilet, Locker room, Rest room, Bathroom, Sauna
Sprinklers activated:	0	**Control damage:**	Not Recorded
Detector Performance:	tector Not in Room operated AND was EFFECTIVE	**Flame damage:**	Not Recorded
General property use:	Residential	**Smoke damage:**	Not Recorded
Specific property use name:	Flats, Apartments, Units over 40	**Avenue of smoke travel:**	Not Recorded
Number of floors:	0	**Avenue of flame travel:**	Not Recorded
iCAD information summary:			
3rd alarm, 6th floor, hotel, fire in bedroom laundry?			

Fire record:	**47**		
Incident Type:	Structure fire with no damage	**Civilians assisted:**	1
Alarm level:	1	**Prior actions:**	Information not recorded
Arrival condition:	No fire or smoke	**Action taken:**	Investigation only (Fire related)
Fire detector type:	Smoke Detector System (Monitored)	**Location of origin:**	Bedroom, Sleeping area, Cell: under 5 persons
Sprinklers activated:	0	**Control damage:**	Not Recorded
Detector Performance:	Detector in Room operated AND was EFFECTIVE	**Flame damage:**	Not Recorded
General property use:	Residential	**Smoke damage:**	Not Recorded
Specific property use name:	Boarding, Half-way house, Dormitory - Other	**Avenue of smoke travel:**	Not Recorded
Number of floors:	0	**Avenue of flame travel:**	Not Recorded
iCAD information summary:			
heater smoking			

Fire record:	**48**		
Incident Type:	Structure fire with no damage	**Civilians assisted:**	1
Alarm level:	1	**Prior actions:**	Isolating power source
Arrival condition:	Out on arrival	**Action taken:**	Investigation only (Fire related)
Fire detector type:	Smoke Detector System (Monitored)	**Location of origin:**	Kitchen, Cooking area
Sprinklers activated:	0	**Control damage:**	Not Recorded
Detector Performance:	Detector in Room operated AND was EFFECTIVE	**Flame damage:**	Not Recorded
General property use:	Residential	**Smoke damage:**	Not Recorded
Specific property use name:	Flats, Apartments, Units over 40	**Avenue of smoke travel:**	Not Recorded
Number of floors:	0	**Avenue of flame travel:**	Not Recorded
iCAD information summary:			
small fire on stovetop, OOA			

Fire record:	**49**		
Incident Type:	Structure fire with no damage	**Civilians assisted:**	3
Alarm level:	1	**Prior actions:**	Information not recorded
Arrival condition:	Smoke only	**Action taken:**	Investigation only (Fire related)
Fire detector type:	Manual Fire Alarm	**Location of origin:**	Ceiling and floor assembly
Sprinklers activated:	0	**Control damage:**	Not Recorded
Detector Performance:	Alerted occupants - detector in room of origin	**Flame damage:**	Not Recorded
General property use:	Commercial, Retail, Manufacturing, Storage	**Smoke damage:**	Not Recorded
Specific property use name:	Office: General business	**Avenue of smoke travel:**	Not Recorded
Number of floors:	0	**Avenue of flame travel:**	Not Recorded
iCAD information summary:			
smoke in fitness studio, coming from ventilation shafts, nothing found			