

# FIREPOINT



IAAI JOURNAL



# Firepoint

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**FIREPOINT:    INTERNATIONAL WINNER OF THE IAAI  
2001/2002 AWARD FOR THE OUTSTANDING PUBLICATION  
OF A CHAPTER NEWSLETTER OR MAGAZINE.**

**EDITORIAL**

In this issue we present two longer case studies. We present the first part of a report from the NSW Fire Brigades on a major fire in Sydney (the second part will be in our next issue), and a report by Ian Moore of a study involving fire modeling and risk assessment.

As the year draws to a close might I wish you all a safe holiday season and the very best for the year ahead.

*Wal Stern*



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## QUEENSLAND CHAPTER REPORT

### Welcome

Welcome to the final edition of Firepoint for 2004. The year is quickly coming to a close and the fire season seems to have arrived early. Queensland's South-East was ablaze during October with numerous grass and bushfires from Maryborough to the Gold Coast. Dozens of firefighters from the States north and far north flew south to assist their colleagues in the South East.

If the events of October are any indication, it is going to be a very long, hot summer for our colleagues within the Emergency Services. "Take Care !"

On behalf of the QAFI Executive, I wish you a very "Merry Christmas & a Happy New Year".

### Conference Review

#### "Motor Vehicle & Machinery Fire Investigation"

*Article by Gary Nash, QAFI President*

As most members of the QAFI would be aware, we recently held our two day conference on Motor Vehicle and Machinery Fire Investigation on 16 & 17 July.

Day 1 was at the Royal on the Park Hotel and was officially opened by Commissioner Lee Johnson of the Queensland Fire and Rescue Service (QFRS). Six 45 minute papers were presented throughout the day, with topics ranging from general fire investigation to forensic locksmith investigations. In addition, six case studies were presented highlighting specific areas of fire investigation. A voluntary exam was held at the end of the day's program and many delegates successfully took up the challenge.

Day 1 ended with the conference dinner, where we were honoured to have Mike Schlattman, the President of the International Association of Arson Investigators (IAAI), address the delegates on developments within the IAAI. Of particular interest was the announcement that the IAAI had received a grant through the US Department of Homeland Security to establish a state of the art website for the fire investigation community. The training system will be operational within 12 months and will be available to all fire investigators, whether or not they are members of the IAAI.

Mike took the opportunity to publicly recognise the efforts of **Ross Brogan** in the regional support of the IAAI, by presenting him with the first **IAAI Presidential Citation**.



The Metropolitan Fire and Emergency Service FIU was presented with an award for **Most Outstanding Fire Investigation Report for 2002**. The award was received by Ian Hunter and Alex Conway.



The night was rounded out by the comic genius of Jimmy Polous, who had everyone in stitches with his accounts of life, as a Greek boy, growing up in Brisbane. The Royal on the Park did a superb job in providing facilities for the day (the only hitch was a minor power interruption). The food was of a very high quality and many compliments were received from delegates.

An early start on Day 2 saw the delegates board buses for the QFRS Training Academy at Whyte Island. After a formal induction and opening of Day 2 by Rod Knight (QFRS Live Fire Manager), we headed over to the Live Fire ground where 4 motor vehicles were burnt to simulate a variety of ignition mechanisms. The burns were quite spectacular and the delegates had the opportunity to examine all the vehicles after they had cooled. In addition to the burns, there were several displays, one illustrated examples of failed engines that may be indicators of a deliberate fire, while others showed electrical and mechanical causes of ignition.

A fire damaged crawler was organised by Keith Spanswick and he laid out the challenge to all delegates to determine the cause of the fire. The background information provided by Keith was that the crawler had reportedly been operating normally when the engine suddenly caught fire. It was actually this small piece of information that was central to the investigation, as examination of the machine revealed that the final drive had failed and that the machine was not capable of "operating normally" when it "caught fire". Although none of the delegates found the critical evidence of the failed drive (hindered access and time restraints did make the examination difficult, though the failure was obvious once pointed out), everyone learnt the significant lesson that evidence relating to the cause of the fire may not always be within the area of fire origin.

Day 2 ended with a practical demonstration of the relative difference in auto ignition temperature of various liquids. Paul Cannington from the QFRS had rigged up an exhaust manifold, which was heated to approximately 500°C by a gas burner and was sequentially sprayed with petrol, diesel fuel, hydraulic oil and brake fluid. All liquids ignited. On the second run, with the manifold now slightly cooler, the petrol did not ignite, whereas the others still did. The demonstration showed that the auto ignition temperature of petrol is higher than that of diesel fuel.

The conference was very well attended, with 90 full registrations and 5 one day registrations. After speakers,

## QUEENSLAND CHAPTER REPORT

committee, QFRS personnel and sponsors are added, the total numbers were around the 120 mark for each day. The conference was the result of a lot of work by a lot of people, in particular, the core of the conference committee, Kate Ridgway (TressCox Lawyers) and Michael Holohan (Quinlan Miller & Treston and now QPS). In addition, significant contributions were made by, Paul Cannington, Craig George, Ted Beitz, Brad Jeffs, Adrian Barry (all QFRS), Robert Campbell (QPS) and Keith Spanswick (Forensic Services Australia). Anyone who has ever presented at a conference knows that an enormous amount of work goes into preparing a paper and the conference would not have been the success it was without the efforts of the speakers, Keith Spanswick, Gerry Te Kapa Coates, Henry Kutek, John Marshall, Les Fuller and David Flint; and the Case Study presenters, Russell Lee, Sean Remedios, Alex Conway, Murray Nystrom, Gary Asmussen and Terry Casey. The largest effort however, was clearly made by our administration officer, Julianne Foley. The conference committee do a lot of work sorting out the "big picture" of the conference; however much of the essentials and the finer detail is left to Julianne to consider and organise. These things are often some of the most time consuming to take care of and without which, the conference would not succeed. So thanks again Julianne for your efforts, patience and dedication.

I would like to end my summary with a very special thank you to Deacons, our association Major Sponsor and our conference sponsors, Freemans (Loss Adjusters), GAB Robins (Loss Adjusters) and Insurance Australia Group (incorporating CGU and NRMA) for their significant support of our association and the conference.



I would also like to thank the delegates from various parts of Australia & New Zealand for supporting the conference with their attendance.

### **"Call to dob in arsonists" – Qld Premier**

On the 17<sup>th</sup> October, Premier Peter Beattie and Emergency Services Minister Chris Cummins today urged Queenslanders to shed their natural reluctance to "dob" when it comes to suspected arsonists.

"Many Australians hold dear the sentiment that you don't 'dob' on others - but arsonists must be dobbed in," Mr Beattie said.

"They are potential murderers who face mandatory life imprisonment.

"Attempted arson carries a maximum sentence of 14 years in jail.

"Juveniles face up to 14 years in detention for an arson the court considers heinous, and up to 7 years in detention for attempted arson.

"These hefty sentences fit the crimes.

"We are facing perhaps the worst bushfire season in 50 years, and this is no time for charity to arsonists.

"Anyone witnessing arson should dob: call your local police station in the first instance, and call Crimestoppers on 1800 333 000 if you have information about arson.

"If you see anyone throwing a cigarette butt out of their car, report their number plate to police or Crimestoppers immediately.

"If everyone is vigilant we can catch arsonists and end their deadly ways," Mr Beattie said.

Mr Cummins said: "There are presently fire bans and a very high fire danger across large areas of the state.

"People lighting fires can and do endanger lives, not only the lives of the property owners, but the firefighters and other emergency services volunteers as well.

"Arsonists cause huge emotional trauma as well as economic and environmental havoc."

The Premier and Minister spelled out the penalties:

Arson (s.461 Criminal Code) Max Penalty = Life (14 years for a juvenile)

Attempted Arson (s.462 Criminal Code) Max Penalty = 14 years (7 years for a juvenile)

- Setting fire to crops (s.463 Criminal Code) Max Penalty = 14 years (7 years for a juvenile)

- Attempting to set fire to crops (s.464 Criminal Code) Max Penalty = 7 years (3 1/2 years for a juvenile)

- Unauthorised Grass Fire (s.146 Fire & Rescue Service Act) Max Penalty = 5 years (or up to \$37500 fine).

"You can also be jailed for up to six months or fined \$3750 for throwing a cigarette butt out a car window," Mr Beattie said.

"The penalties increase to up to a year in prison or an \$18,750 slug if a state-wide fire emergency is declared.

"I find it amazing that people could be so careless during the current fire conditions," he said.

"Through this one careless act by throwing your cigarette butt out the window, you could be endangering the lives of residents and firefighters - it could even be your own family and friends as well. Also, you could be putting people's homes and livelihood at risk."

Mr Cummins said the state's fire services - which include volunteer, auxiliary and permanent firefighters - are well-drilled and well-equipped.

"It is up to all Queenslanders and visitors to our state to make sure the brave people who fight fires - many of whom are volunteers - are not facing an excessive and dangerous workload," he said.

"We have seen people's homes and livelihoods come under threat from these bushfires, sadly we have lost

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some homes - and we have seen firefighters injured whilst protecting their communities.

"It is unfair and unconscionable to place the safety of firefighters at risk as the result of deliberate fire setting and carelessness," Mr Cummins said.

### Membership

On behalf of the QAFI executive & members, I extend a warm welcome to the following new members -

- Ben INGRAM, Pacific Claims Group - Maroochydore
- Neil WHITING, M&E Partnership (PNG) - Port Moresby

Membership renewal invoices for the membership period 1/1/05 to 31/12/05 will be issued early December 2004. Membership dues will be payable by the end of January 2004. If you do not receive your membership renewal notice, please contact [admin\\_officer@qafi.asn.au](mailto:admin_officer@qafi.asn.au)

It would be appreciated if members who have changed their e-mail address or contact details in any way over the past twelve months and not advised us could do so as soon as possible. E-mail is our primary stream of communicating with members and also for distributing meeting, seminar and conference invitations and registration forms.

Not sure if you have advise your current e-mail address? Send a quick e-mail to Julianne anyway. [admin\\_officer@qafi.asn.au](mailto:admin_officer@qafi.asn.au)

### Diary Dates

**Brisbane, March 2005 - "Advance Notice"**

**One Day Seminar - "Rights Of Access & Rights of Evidence Seizure"**

Full details will be distributed early 2005.

**24<sup>th</sup> to 29<sup>th</sup> April, 2005**

**56<sup>th</sup> IAAI Annual Conference & AGM - Washington D.C.**

The best instructors throughout the world have been chosen to present today's key topics at this year's conference. Field trips to the Bureau of Alcohol Tobacco and Firearms (ATF) crime scene laboratories and to the National Institute of Science and Technology (NIST) laboratories will be available for those who desire to attend these off-site sessions. Don't miss this important opportunity to learn from these renowned instructors.

A full week of quality education will be presented in all areas. You pick the classes that best suit your needs.

Download the registration form at [www.firearson.com](http://www.firearson.com)

### Association Sponsor

On behalf of the QAFI Executive Committee and members, I wish to sincerely thank our 2004 Association Annual Sponsor for their ongoing support.



**Deacons**

The QAFI Annual Sponsorship program has been in operation for a number of years and assists with not only the administration and liability insurance costs (45% of membership fees is used to pay our liability insurance), but also the added costs of training initiatives such as Conferences, Workshops and Member seminars and meetings.

2005 promises to be an exciting year for those involved in the investigation of the cause and origin of fires and we will be distributing to all members and interested parties invitations to participate in the 2005 Annual Association Sponsorship Program.

All sponsorship applications must be received by Friday 30<sup>th</sup> January 2005.

For further information on the sponsorship program please contact Julianne via e-mail on [admin\\_officer@qafi.asn.au](mailto:admin_officer@qafi.asn.au)

### Congratulations - A baby Girl !!

Our congratulations go to Kate Ridgway (QAFI Immediate Past President) & Paul Cannington (QFRS) on the safe arrival of their baby daughter Jessica.

The executive committee recently had the pleasure of Jessica's company at our October committee meeting.

### Farewell Bob!

It is with regret that we farewell one of our executive committee members. Robert (Bob) Campbell of the Queensland Police Service - Arson Unit recently accepted a transfer to another department which takes him out of the fire investigation arena. Bob tendered his resignation at the September meeting of the QAFI executive committee.

On behalf of the executive committee and members, I wish to sincerely thank Bob for his support of the QAFI over the years and wish him every success in his new role.



## NSW ASSOCIATION OF FIRE INVESTIGATORS INC (IAAI CHAPTER No.47)

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### **PRESIDENT'S REPORT**

As this is my first report as President of the NSW Association I thought it appropriate that I tell you something about myself.

I have been on the committee of the Association for the last four years, working with both Don Walshe and Richard Woods when they were in the chair. I have been working in the fire industry for the last twenty years as an operational firefighter and officer with the NSW Fire Brigades. I currently work with the NSW Fire Brigades as a Fire Investigator in the Fire Investigation and Research Unit.

The invested committee for this year has many new faces. It was heartening to see so many young individuals from across the spectrum of our industry willing to donate some of their time to further the causes of fire investigation. We now have representation from tertiary institutions, private industry as well as the emergency services and the police. I am excited and encouraged by

their enthusiasm and greatly look forward to the wonderful events that will ensue.

In our preliminary meetings, the committee has already expressed a strong focus on education for its members. To this end, the committee and I intend to review and evaluate world's best practice in the area of continuing professional development to ensure that all members are recognised throughout the industry not only for their qualifications but also for the way that they have maintained and utilised those qualifications over the years. It is through this process that we believe our members will gain the recognition they deserve.

Our Major Conference, planned for August of 2005, is beginning to take shape. We intend to focus on the area of fires involving electricity and electrical appliances, with two days of lectures preceded by a one day practical workshop. Our international speakers have already provided commitments to present,

adding to the considerable local talent we have. It is hoped that this conference will go a long way to unravelling some of the many mysteries involving electrically initiated fires.

We will also continue to provide you with up-to-date information and great networking opportunities through our free education evenings. The committee sees great value in exposing our membership to the industry's best operators, who are keen to pass on some of their knowledge and skills that we all know you can't just learn from a book.

In closing, I look forward to the challenges ahead. I strongly believe that the present committee more closely represents the key stakeholders in our industry than it has ever done. With their help and your support it is my belief that the science of professional fire investigation will be promoted to new and exciting heights.  
Kind Regards

**Paul Bailey F.I.Fire.E**  
**NSW AFI President.**

## Victorian Chapter News

### VAFI WEBSITE

All members should be sure to visit the Victorian AFI website on <http://vicfire.com> and check the notice board for future activities and general notices. Check out your committee. Photo Contest winners will be displayed when all entries have been finalized. If you have any suggestions for the website, please contact Trevor or any of the committee.

### AGM REPORT

The AGM of the VAFI was held at Bells Hotel in South Melbourne on the 13<sup>th</sup> September 2004. Although a small number attended the meeting it was presented with reports from the President and Secretary. The President thanked the members of the committee for their work over the last year. Special thanks to Bob Hetherington for his work as registrar and for attendance to legal matters. The Treasurer's report showed that the Chapter is financial, has a

membership of 181 and currently has 114 financial members.

There was a withdrawal from the committee of Marcus Boorman from the Arson Squad, who has been selected for overseas service. Good luck and a safe return.

Elections for 2004/2006 were as follows:

*Vice President*  
Brian Neal  
*Treasurer*  
Bob Hetherington  
*Committee*  
George Cooney  
John Kelleher  
Norm Johnson  
Vacancy

### GENERAL BUSINESS

OH & S Seminar to be held over to early 2005. Training Sessions to be held were discussed. Committee Meeting to be held regularly, 2<sup>nd</sup> Wednesday monthly. Fees as from 1 July 2005 to be \$40.00 per annum. Members then retired to the bar for refreshments.

### TRAINING SESSION

29 OCTOBER 2004  
PRESENTATION

This training session was held at the MFB Training Room at Victoria Street Abbotsford and presented four case studies for review.

Operation Rowel was the police operation in the collection of information and conviction of John Bennett. This started from 3 fires over an 11 month period which endangered people and caused a fatality at Christerin Hotel. Although the incidents were in Sale, Victoria, information and fire history was received from Tasmania. There was some discussion about covert police operations which had been reported in the newspapers. This case resulted in a conviction of 12 years.

Following this, a review of the operations of the Office of Gas Safety (OGS) was presented of the recall of gas wall ovens as a result of fires that had occurred.

(continued on page 22)



## A NSW Fire Brigades Post Incident Summary Report

**Incident:** Aristocrat Spas Factory Fire  
**Address:** 21, 23/314 Hoxton Park Rd, Prestons  
**Council:** Liverpool City Council  
**Date of Incident:** 02/03/04  
**Time of Incident:** 0543 hours



### Issues of Significance:

1. Loss of Integrity of tilt slab construction resulting from impact of fire, in particular, the bracing to columns designed to support the tilt slabs.
2. Destruction of surveillance video computer hard drives impacting on fire, police, and insurance company investigations.
3. Arrangement of storage racks perpendicular to skylights allowing faster fire spread.

### Building

**Building Use:** Manufacture and Storage  
**Construction Type:** Walls — Tilt Slab  
Floor — Concrete  
Roof — Iron  
**Number of Levels:** One  
**Floor Area:** 600m<sup>2</sup>

## Fire Protection

<b>Sprinklers:</b>	Nil
<b>Alarm System:</b>	Nil
<b>Hose Reels:</b>	Yes
<b>Extinguishers:</b>	Yes
<b>Hydrant System:</b>	Yes

## Consequences

<b>Fire cause:</b>	Undetermined
<b>Fire origin:</b>	Eastern Wall – Under Workbench
<b>Estimated Property Loss:</b>	90%
<b>Estimated Dollar Loss:</b>	<b>Building</b> — \$1 000 000 : <b>Contents</b> —\$1 000 000 + \$200 000 (Adjoining premises)
<b>Evacuations:</b>	Nil
<b>Injuries:</b>	Nil
<b>Fatalities:</b>	Nil

## NSW Fire Brigades

<b>Stations in Attendance:</b>	12
<b>Fire Brigades Personnel:</b>	60
<b>Man hours (firefighting):</b>	360

## Building Description

The factory complex at 314 Hoxton Park Rd, Prestons was constructed in 1985 and consisted of 23 single-level factory units each with a mezzanine office area. Entry to each unit was through glass double doors near which was a stairway leading to the mezzanine office area. The office area was of lightweight construction. The external walls (and some dividing walls) were concrete tilt slab construction. Floor-to-ceiling single-skin brick walls were used as partition walls between the remainder of the units. See Appendix B for the site plan and Appendix C for the affected unit floor plans.

The walls were supported using 355mm x 170 mm rolled steel I-Beam (RSJ) columns. Welded to the steel columns, at 1200 mm intervals, were 200 x 100 x 10 mm plates which attached to the tilt slabs by way of a bolt secured through the plate into the slabs.

The roof was constructed of 'Kliplock<sup>TM</sup>' steel sheeting supported by steel roof trusses. The trusses were attached to the wall columns using a bolt fastening system. The roof had fibreglass skylights every 4m which were approximately 500mm wide. These skylights ran the width of the roof area from East to West with no break between the factory units.

All units had a stairway near the entry doors leading to a mezzanine office area with windows. Unit 21 had a surveillance video computer located in this office area on a table near the window. Unit 21 measured approximately 38 x 16.5 metres and consisted of a showroom with approximately 10 spa units, a high bay rack with 4 spas set up for testing and various high bay racking systems for storage around the unit complex.



*Photo 1 :Aerial view of roofing showing skylights every 4 metres. Note aerial platform at work from Lyn Pde.*

Unit 23 measured 24.5 x 16 metres and consisted of rack systems used for storage of finished spa units and spare parts. The racking system was made of light steel and was up to 6 metres in height.

*Photo 2:  
Factory unit on the  
northern side of unit  
21 showing product  
storage on high bay  
racking systems.*



## Fire Protection Systems

There were two pillar hydrants in the factory complex car park and there were hose reels uniformly distributed around the exterior of the units. Fire extinguishers were also stored near the exit doors inside the units in accordance with Australian Standards 2444 (Sect 1-4).

During the incident, problems were experienced with the Brigade Booster and stop valve not being able to be closed in order to pressurise the hydrant system. A complaint in regard to the booster system being damaged and not being maintained had been received on the 27<sup>th</sup> February 2003. An Order 6 relating to the booster system and its maintenance had been placed on the complex by Fire Safety on the same day (FSD/POL/133319). A follow-up inspection was carried out on the 11<sup>th</sup> March 2003 and it was determined that the order had not been complied with. The matter was referred to Liverpool City Council for further action.

## FIRE INCIDENT EVENTS

At 0544 hrs on Tuesday March 2, 2004, NSW Fire Brigades from 31 Busby and 7 Horningsea Park responded to a factory fire reported to be at 10 Lyn Parade, Prestons. Enroute to the incident, State Communications (Comms) informed the attending stations of numerous calls being received and upgraded the response to a 2nd alarm. Station Officer Jamie Towle, noticing large volumes of smoke coming from the vicinity as he approached, immediately upgraded the incident to a 3rd alarm at 0550 hours.

31 Pumper entered 5 Lyn Parade observing flames that were rising 5 to 10 metres above the roof level and approximately 30 metres north of their location. They entered several other factory sites in the immediate area in an attempt to locate the fire.

At 0556 hours, 7 Pumper sent a message that they had located the fire at number 314 Hoxton Park Road and Comms subsequently advised all responding appliances to enter from that address.

At 0557 hours, Operational Commander West 6, Ken McDonald, was notified and responded.

At 0602, 31 Pumper joined 7 and 8 Pumpers, and 8 Rescue and Ladder Platform outside Aristocrat Pools and Spas, units 21 and 23 respectively.

A further message was sent by 31 Pumper stating that unit 21 was fully involved in fire with heavy black smoke and 8 to 10 metre flames billowing through the roof. Crews wearing breathing apparatus and with hose lines were attempting to gain access to the fire. The external door to unit 21 was opened by an employee who was at a coffee shop nearby at the time of alarm. Crews with hose lines noticed flames clearly visible through the entry door to the factory area and around the edges of the 4m x 5m roller door adjacent. The fire had already spread to unit 23 as was evidenced by discoloured paint on the roller door diagonally from top left to bottom right.

At 0638, Operational Commander McDonald sent a message stating that crews were at work utilising hand lines and had contained the fire to units 21 and 23. Crews from 84 Pumper, 101 Pumper and 49 Pumper joined to protect unit 19 by internal attack of unit 21 and the mezzanine level with 38mm hose lines from 7 Pumper. Hazmat 9 Bravo and 9CO2 had arrived in the interim at about 0620 hrs. 92 Pumper had been sent to protect the southern exposures. Zone Commander West 1 Ray Kelly and Zone Commander West 2 Andy McLeod were responded and arrived at the incident at 0646.

At 0653 hours, Incident Control Vehicle Alpha declared a 4<sup>th</sup> alarm and Assistant Commissioner Murray Kear, 41 Pumper and 73 Pumper were responded along with Inspector Paul Bailey, NSWFB Fire Investigation and Research Unit, and Station Officer Mark Cavanough. Ladder Platform 8 cut a hole in the roof of the adjacent unit 22 (INZ Kitchens) to release smoke build up and to provide exposure protection from that point.

At 0713 hours, Zone Commander Ray Kelly assumed control. At 0724 hours, Zone Commander Kelly relayed a message as to his concern about the instability of the external Eastern and Southern tilt slab walls. Following further consultation, at 0755 hours Zone Commander Kelly requested a Liverpool Council structural engineer to assess the integrity of the tilt slab walls on the rear boundaries.

At approximately 0800 hours a coordinated attack was made on units 21 and 23 with hand lines and positive-pressure ventilation fans. The fire was quickly subdued and crews were able to move freely inside to complete extinguishment of the fire. The interior brick wall separating the two units had failed during fire fighting operations and a small fire burning under that wall was proving difficult to extinguish.

At 0850 hours, the structural engineer from Liverpool Council advised Zone Commander Kelly that the remaining portion of the single skin brick wall was unstable and all fire crews were removed from inside the premises. By this time, the fire had been mostly extinguished and a stop message indicating the fire was out, followed shortly after at 0906 hours.

The structure and contents of units 21 and 23 were extensively damaged by fire with additional units 20 and 22 being severely affected by smoke damage. One ladder platform was used with 4 pumps in relay and numerous hand lines from pumps with crews in breathing apparatus were all used to extinguish the fire. A second ladder platform was used as an observation tower in a number of locations surrounding the incident.

Mechanical ventilation together with natural ventilation was used to clear the atmosphere and allow for greater visibility inside the factory. The incident was scaled down to 3 pumpers and the investigation team until 1322 hours when the fire duty was terminated and the premises was handed over to the building insurer.

## **Fire Investigation**

Inspector Paul Bailey was the on-shift fire investigator and responded at 0653 hours when a 4<sup>th</sup> alarm was declared. He arrived at the incident to begin his investigation at approximately 0730 hours. After he liaised with the incident controller, he performed an initial overall scene examination then spoke to the first arriving officers in order to gather information about the incident.

He began interviews with witnesses as well as the employees and managers of the factory whilst the incident was still in progress. He was unable to commence an internal investigation of the scene at this time. The information gathered through interviews at this early stage proved invaluable in reinforcing his theories on the point of origin later. Many witnesses left the scene by mid morning and, had the investigator arrived any later, the information might not have been gathered.

At around 0830, Inspector Bailey began his investigation inside the factory. After carrying out inspections of both affected units and eliminating several possible areas of origin, he determined that the fire started on the Eastern wall under a bench. Plastic pipe-bending heat machines were used in this area. After an interview with the operations supervisor and an inspection of these machines, Inspector Bailey concluded, however, that they did not contribute to the cause of the fire. Although the area and point of origin were firmly established, the extensive damage and lack of positive evidence resulted in the fire cause being declared "undetermined".

### **1. Imminent failure of tilt slab construction from fire impact.**

The external walls of the complex (and some of the internal dividing walls) were of pre cast tilt slab construction; each slab panel measured approximately 8 x 7 x 0.12 metres. The panels were attached to the unprotected steel columns by way of steel plates (measuring 0.2 x 0.1 x 0.012 m) that were welded to the column and bolted to the slabs at 1.2 metre intervals using a "Loxin<sup>TM</sup> style" bolt fixing system.

Although none of the walls collapsed during fire fighting operations, there were substantial deflections both inwards and outwards as a result of heat impact on the steel columns and on the attached roof support beams. The roof structural support beams began to fail and deflect downwards and their weight pulled the steel columns inwards (See *Photo 5*).

On the upper steel plates, many of the welds (which joined the plates to the columns) failed leaving the columns to pull inwards away from the tilt slabs. This left some sections attached only by a single plate (See *Photo 7*).

During the incident, Liverpool Council engineers were called in to determine the possibility of structural collapse. On their recommendation, all internal fire fighting operations ceased at approximately 0850 hours. The entire building was subsequently condemned. A short time after the incident, Liverpool Council ordered the demolition of units 21 and 23 due to their structural instability. The Liverpool Council engineer mentioned that there had been cases in other structures in which the bolts attaching the plates to the tilt slabs were either made of nylon or were not long enough to attach to the wall.



According to West Australian Government records from 2002, in one documented instance, the bolt heads were attached to the plate by spot weld to give the impression that a bolt had been used through to the slab (WA Govt, 2002).



*Photo 3:  
Point of origin on  
Eastern wall. The burn  
patterns indicate the fire  
originated under the  
bench.*

**This is the first part of this report from the NSW Fire Brigade. The second and concluding part will be included in the next issue of “Firepoint”.**

## **Application for Membership**

### ***Association of Fire Investigators*** ***(A Chapter of the International Association of Arson Investigators)***

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I hereby apply for membership of the Association of Fire Investigators in the State of ..... in accordance with its constitution and by-laws, and agree to be bound thereby.

I attach the amount of \$..... in payment of annual dues.

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1. Name in Full
2. Address for Mail
3. Position Held (e.g. police or fire brigade officer, lawyer, investigator, assessor)
4. Company/Agency
5. Telephone
6. Mobile
7. Fax No.
8. E-mail Address
9. Signature
10. Name of Member Recommending you
11. Telephone No. of Member
12. Address or E-mail No. of Member
13. Signature of Recommending Member

Give your completed form with your payment to any committee member of the Association, or mail it to the appropriate postal address, as shown on page 3. This page also lists contact names and numbers if you have any inquiries.

# USE OF FIRE MODELLING AND RISK ASSESSMENT TO AID IN DETERMINING QUANTUM – A CASE STUDY

*Ian Moore  
Pitt & Sherry*



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*Ian has had over 15 years experience as a fire and risk specialist.*

## ABSTRACT

This paper considers the application of fire test results, fire modelling and Quantitative Risk Analysis as an aid to determining the recoverable quantum resulting from a fire loss in a multi-storey office building in Sydney, NSW.

The author was commissioned to determine the probability of fire and smoke spread and human intervention with the aim of answering the following questions that effect the quantum of the loss.

1. Whether a proper alarm would have given a fire warden or other person in the vicinity a reasonable chance to effect extinguishment of the initial fire depending on the fire (smoke) conditions at the time.

2. What was the percentage chance that a nearby person had of fighting the fire and extinguishing the fire?

An experimental program, fire modelling and Quantitative Risk Assessment techniques were designed and performed in order to answer the questions.

The results of the assessment indicated that an occupant would have a 13% probability of extinguishing the fire had the alarm panel been connected to the detector panel and an alarm had been raised assuming that fighting the fire were their only response. If other responses were allowed the probability of extinguishing was decreased to 2-3%.

## INTRODUCTION

The fire occurred at approximately 2:30pm on 7 September 1994 on the second level of a multi-level office building trapping 9 people on the second and twelfth floors. The result of the forensic fire scene investigation revealed that the fire initiated within a stack of office chairs located in a vacant area on the second level. Ignition of the fire was indicated to be as a result of arson or failure of a fluorescent light located above the chairs. The conclusion of arson was supported by witness observations of an unknown male leaving the second floor immediately prior to the fire.

The occupants became trapped due to an alarm failure caused by a connection fault between the thermal detector panel and the Early Warning Intercommunication System

(EWIS) panel. Consequently occupants were not alerted to the presence of the fire until the smoke was observed filling the empty office space and issuing from the air-conditioning vents.

In particular the author was requested to provide an answer to the following questions:

1. Whether a proper alarm from the EWIS system would have given a fire warden or other person in the vicinity a reasonable chance to effect extinguishment of the initial fire depending on the fire (smoke) conditions at the time. That is, was the fire sufficiently small at the stages of development and not growing at a rapid rate such that the response time of the thermal detectors would have given a nearby warden or other person a reasonable prospect of extinguishing it.
2. What was the percentage chance that a nearby person had of fighting the fire and extinguishing the fire?

It was understood, based on the information provided that a portable extinguisher and a fire hose were available to the occupants for extinguishment of a fire.

The methodology used in answering the above questions was:

1. Review available witness's statements and fire investigation report
2. Perform ignition fire tests to determine the ease of ignition,

fire behaviour and possible maximum fire size for the full-scale fire tests

3. Perform full-scale fire tests to obtain input data with regard to fire and smoke production rates.

4. Use the input data to "calibrate" the smoke spread model for the fuel load configurations encountered.

5. Using the "calibrated" input data files, use the smoke-spread model to predict conditions within the building as a result of the real fire.

6. Develop an event tree involving the time of occupant response, the radial distance of the fire from the thermal detector, type of chair first ignited and type of extinguishing agent used, was developed in order to determine the "percentage chance" that the fire could be extinguished.

7. Determine the probability of a person responding and extinguishing the fire based on the smoke and fire conditions likely to be encountered at the time of alarm and their arrival at the fire scene and the time for thermal detector activation.

The chosen methodology indicates the importance of calibrating any model inputs and performing multiple runs of any model in order to determine any limitations and assumptions that may affect the results of the model.

The case study also demonstrates the power of combining fire investigation, fire modelling and engineering with quantitative risk analysis to aid counsel in reaching a decision on the quantum of loss based on the balance of probabilities.

## BACKGROUND

The subject fire was indicated to have initiated on the 2nd floor of the 13-storey office building in association with a large collection (200-250) of stacked chairs.

The chairs were indicated to be a mixture of foam padded/wool fabric covered steel framed chairs, and vinyl covered foam padded plastic chairs on steel frames. The chairs were all straight-backed office style chairs. Based on a review of the supplied photographs from the fire investigation it was estimated that greater than 80% of the chairs were of the vinyl type.

The return air dampers on the floor of fire origin were indicated to have failed to close. Accordingly, smoke and hot gases were able to travel the full height of the building via the return airshafts trapping occupants on Level 12 of the building.

The occupants of an accounting firm, also located on Level 2, were the closet occupants to the developing fire.

It was indicated that upon detection of the fire, by the thermal detector situated directly above the stack of chairs, that the Thermal Detector Panel activated, thereby activating the fire alarm bell located outside the building and sending a signal to the fire brigade.

The Early Warning Inter-communication System (EWIS) was indicated not to have been correctly connected to the Thermal Detector panel. The result was that no alarm signal was raised within the building until the EWIS panel was manually operated by the Building Superintendent. Accordingly, the occupants of

the building did not receive an alarm signal at the time the thermal detector activated.

Those occupants trapped by the fire were alerted to the fire via visual cues.

## REVIEW OF STATEMENT AND TRANSCRIPTS

Based on the witness statements the significant points with respect to the rate of fire growth and the occupant's reactions include:

1. The occupants of the accounting office acted reasonably quickly to the verbal warning of a fire, especially the fire warden who went to investigate the fire immediately upon hearing the warning.
2. The fire took between 6-10 minutes (360-600 seconds) to develop from being undetectable on level 2 to filling the vacant level 2 area with smoke.
3. The initial reaction of the fire warden, on level 2 was to investigate the fire rather than attempt to evacuate the occupants.

## FIRE IGNITION TESTS

The results of the ignition tests are summarised below:

1. The chairs were not easily ignited by a small ignition source such as a hexamine pill or small flame from a butane burner. However, the fire investigator found that the cloth-covered chairs could be ignited at the base of the backrest using a cigarette lighter.
2. Ignition of the chairs was achieved via A4 sized sheets of crumpled paper placed between the seats of

the wool covered chairs and between the backs of the vinyl chairs

3. The results of the tests tended to suggest that ignition due to a faulty light spraying hot objects onto the seats may not have been the cause.

The fire tests and modelling were used to determine if it was possible for a person to extinguish a fire. Accordingly, the faster the rate of fire growth used in the modelling the more conservative the answer. As a match applied to the rear of the chair seat produced a slower growing fire than using paper placed between the seats, the latter was used as the ignition source for all full scale fire tests upon which the modelling would be based.

The vinyl chairs produced flaming droplets and a flaming molten pool of plastic below the chairs. Rapid flame spread from one stack of chairs to another therefore most likely occurred due to radiation from the hot gas layer, fire plume and flames across the ceiling, as well as the formation and flow of molten pools of burning plastic.

## FULL SCALE FIRE TESTS

In order to determine if a nearby person had a chance at extinguishing the fire with a hand held fire extinguisher, the rate of fire and smoke development resulting from the stack of chairs burning had to be estimated. The rate of fire and smoke spread was then used as input data into the smoke spread model used to predict the conditions resulting from the real fire.

A series of fire tests, using chairs indicated to be similar to those involved in the actual

fire, were performed. Based on the observations of the ignition tests and a review of the information received the following full-scale fire tests were developed to provide a reasonable estimation of the actual fire:

Test 1: - Ignition of a stack of four cloth covered chairs using paper placed between the seats of the bottom stack.

Test 2: - Ignition of a stack of four vinyl chairs using paper placed down the back.

The results of the full-scale fire tests indicated that, for both chair stack arrangements used, the fires did not develop significantly until after 200 seconds from the time of ignition. Development then continued for the next 100 seconds after which fire development was more rapid until flashover occurred. The change in the rate of fire development was associated with the formation of flaming droplets and molten pools of polyurethane and vinyl below the chairs

The methodology used in the calibration process was to model the fire within the tests. The predicted rate of smoke production was then varied with time, until the density of smoke matched that obtained from the full-scale fire tests.

## SMOKE SPREAD MODELLING OF THE ACTUAL FIRE

The input fire data obtained from the full-scale fire experiments was used to predict the smoke and fire conditions present during the early stages of the actual fire.

The floor area of Level 2 of the office building and the corridor in front of the accounting firm

were modelled as three compartments.

Two fire scenarios were considered based on the results of the full-scale fire tests, viz

Scenario 1 – Based on the results of test 1 of a stack of four cloth covered chairs using paper placed between the seats of the bottom stack.

Scenario 2 – Based on the results of 2 involving ignition of a stack of 4 vinyl chairs using paper placed down the back.

It was assumed that the probability of each scenario occurring was equal to the proportion of the type of chairs first ignited. Based on the supplied photographs it was considered that greater than 80% of the chairs were of the vinyl type. Accordingly, it was considered that Scenario 1 had a 20% probability of occurring while Scenario 2 had an 80% probability of occurring.

The results indicated that the area adjacent to the fire became untenable prior to those areas more remote from the fire. Untenable conditions were developed once the smoke layer descended below head height, ie 2.1m, due to both the temperature and the smoke density. The results therefore suggest that once the smoke layer descended that the occupants would be exposed to hot smoke and find it difficult to see their way out.

The results predicted by the model were in line with the witnesses statements that indicated that the smoke layer had developed from being undetectable to completely smoke logging the Level 2 area in approximately 360-600 seconds.



The occupants also indicated that they could feel the heat from the fire and smoke when in the corridor. The modelling results indicated that the time for the smoke layer within the corridor to reach 100°C was in excess of 500 seconds for Scenario 1 and 650 seconds for Scenario 2. This was considered to be reasonably consistent with the occupant's observations in that they could feel the heat, but it was not hot enough to prevent them from entering the smoke within the corridor.

The scenario-involving ignition of the fabric-covered seats was found to be more severe than the scenario-involving ignition of the vinyl seats.

## TIME TO ACTIVATION OF THE THERMAL DETECTORS

The time to activation of the thermal detector located above the chairs was predicted using the data obtained from the full-scale fire experiments and the smoke spread modelling.

The fire investigator report indicated that the thermal detector was located above the stack of chairs. However, the radial distance between the detector and the fire could not be precisely determined, as the exact point of fire origin could not be determined. Accordingly, an analysis was performed assuming radial distances of 0.1m, 0.5m, 0.7, 0.8 and 10m.

The activation time of the thermal detectors was predicted using DETACT<sup>(3)</sup>. The probability that the detector was within a certain distance of the fire was determined by assuming an area of the stacked chairs of 10m<sup>2</sup>.

For a radial distance of 0.1m the area of coverage was equal to 0.03m<sup>2</sup>. Accordingly, the probability that the fire initiated within the 0.1m of the detector, P0.1 was given by:

$$P0.1 = 0.03/10 \times 100 = 0.3\%$$

Using the same technique for other radial distances the probabilities that the detector will be within 0.5m (P0.5), 0.7m (P0.7), 0.8m (P0.8) and 1.0m (P1.0) were equal to 8%, 15%, 20% and 31% respectively.

## OCCUPANT RESPONSE AND TRAVEL TIME

### Response and Coping Time

Assuming that the Thermal Detector Panel was connected to the EWIS panel, then once the thermal detector had activated an alarm, the occupants of the building would go through a number of stages prior to commencing evacuation or taking action. The time to perform those stages is generally referred to as the response and coping time or pre-movement time.

In the case of the subject fire where there were wardens present, ie the response stage would involve recognising the alarm as a fire alarm while the coping stage would involve deciding to investigate and fight the fire or evacuate.

The time taken for responding and coping to a fire alarm is a function of the type of alarm, time of day, pre-alarm activities of the occupants, and the level of training. It is generally considered that the higher the level of training the quicker the response and coping times. Accordingly, in an office<sup>(4)</sup> environment where the occupants are alert and mobile the response and coping

times are expected to be small. The time for a warden is expected to be even smaller. The statement by the fire warden indicated that he responded extremely quickly to the verbal warning of the staff member. A time of 30 or 60 seconds was used as a reasonable approximation of the range in response and coping time.

Proulx and Fahy<sup>(5)</sup> determined the number of occupants responding to a fire alarm based on the results of fire drills in two office buildings. The time to start, ie the pre-movement was taken as the time taken for the occupants of the office to cross the door or to step outside the area of their dividing panels. Their results indicated that the average times to start moving in the two office buildings were approximately 0:36 seconds and 1:03 minutes respectively. Re-arranging their data into a cumulative probability the probability that the occupants will respond in 30 seconds was predicted to be 18% and in 60 seconds was predicted to be 46%.

Nelson MacLennan<sup>(6)</sup> suggest a range in travel speed for walking occupants of 1.19 – 1.40 m/s. Pauls<sup>(7)</sup> indicates that a travel speed of 1.2m/s is reasonable in moderately crowded situations for able-bodied persons on open floors. For the purposes of this study a travel speed of 1.0m/s was assumed to allow for the possible reduction in travel speed due to carrying of the fire extinguisher or fire hose. Based on the floor plan layout provided it was assumed that an occupant of the accounting firm would have a travel distance of approximately 40m to the fire. Therefore a travel time of 40 seconds has been assumed.

It was considered that it would take a trained fire warden approximately 30 seconds to remove the fire extinguisher or fire hose from its mount.

The total travel time was therefore assumed to be 70 seconds.

## **POSSIBILITY OF OCCUPANT INTERVENTION**

### **Time to Start Fire Fighting**

The results of the smoke spread and occupant movement modelling, in terms of the time for detection, response and coping times and travel time compared with the time for untenable conditions were determined.

The results indicated that a fire warden would have been able to reach the fire prior to the development of untenable conditions for all scenarios except for Scenario 1 when a 60 second response and coping time was assumed and the detector was assumed to be 1.0m or greater from the seat of the fire.

Given that having reached the fire the warden would then have to activate the extinguisher if he were to have an effect on the fires development, it was considered that he would have to reach the fire approximately 60 seconds prior to the development of untenable conditions. The use of a 60 second safety margin is also considered to take into account any extended time to activate the fire hose. Accordingly, the following scenarios were considered not to provide sufficient time for a warden to attempt to extinguish the fire:

i. Scenario 1, 1.0m radial distance, 30 second response time

ii. Scenario 1, > 0.7m radial distance, 60 second response time

iii. Scenario 2, 1.0m radial distance, 60 second response time

Based on the results of the full-scale fire tests and the predicated arrival times for the fire warden, it was considered that the area of flame would be less than  $1.2\text{m}^2$  (13ft<sup>2</sup>) in all cases.

Figure 11.12 from the Guidelines<sup>(2)</sup> indicates that a trained employee from a fire team would have a greater than 98% probability of extinguishing the fire. A single person with an extinguisher would have approximately 95% probability of extinguishing the fire. It is considered that the abilities of a fire warden would fall between the above two types of people.

The above figures are based on extinguishment of wood cribs and pool fires. Hence, they were considered to be optimistic given that the person attempting to extinguish the subject fire would have a developing smoke layer above them that would serve as a distraction and lead to less efficient fire fighting. The configuration of the chair stacks would also make extinguishment more difficult.

As a conservative assumption the above values were reduced by half, ie the probability of extinguishment using a portable extinguisher was equal to 48%. And approximately 70%, if a fire hose were used.

The probability that a person would use a fire hose in preference to an extinguisher was not reported in the literature. An estimate that 80% of people would use an extinguisher and 20% would use a fire hose was therefore

used but subject to a sensitivity analysis.

## **PROBABILITY OF EXTINGUISHMENT**

The probability that the warden would attempt and succeed in extinguishing the fire was calculated using an event tree and the probabilities for the various events occurring. A total of 1250 scenarios were enumerated.

The event trees enumerated incorporated the following factors:

1. Fire ignition scenario.
2. Radial distance of the detector from the fire.
3. Response time of the fire warden.
4. Whether the fire is extinguished or not.

The event tree considers three possible response and coping times, less than 30 seconds, 30 to 60 seconds and greater than 60 seconds.

The probability that a person responds in 30 seconds based on the work of Proulx<sup>(5)</sup> was assumed to be 18%. Accordingly, there is a 72% probability that they will not respond in 30 seconds.

Occupants have a 46% probability of responding in less than 60 seconds. Therefore, the probability that they will respond between 30 and 60 seconds is equal to  $72\% \times 0.46 = 33\%$ .

The probability that the occupants do not respond in 60 seconds is equal to  $72\% \times 0.54 = 39\%$ .

### **Probability of Extinguishment**

Based on the results of the event tree analysis, it was considered that if it was

assumed that the fire would immediately attempt to extinguish the fire upon hearing of the alarm, that there was a 13% probability that the fire would be extinguished.

However, if it assumed that the fire warden may be able to take other actions such as evacuate the building, then there was a  $12\% \times 0.19 = 2.3\%$  probability that the fire would be extinguished.

The above probability of 2.3% is based on the average percentage of US and British study populations that attempted fire fighting<sup>(4)</sup>.

The study populations included all occupants rather than just fire wardens. As a fire warden is trained in fire extinguishment, and the statement by the fire warden, indicated that he immediately went to investigate the fire alarm rather than start evacuation procedures, it is considered that the above probability is conservative.

#### CONCLUSIONS

On the basis of the information provided, fire test results and results of the smoke spread modelling the following conclusions can be provided in relation to the subject fire loss:

1. An alarm signal from the EWIS system would have given a fire warden or other person in the vicinity of the fire a chance to effect reasonable extinguishment.
2. If it was assumed that a warden would attempt to extinguish the fire, the probability that the fire would be extinguished is predicted to be 13.5%.
3. If it was assumed that the warden can take a number of actions, only one of

which was to extinguish the fire, then the probability of extinguishment is predicted to be 2.3%.

The results of the analysis indicate the power of Quantitative Risk Analysis in assisting in determining a level of quantum taking into account multiple variables.

#### REFERENCES

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4. Bryan J., "Behavioural Response to Fire and Smoke", SFPE Handbook of Fire Protection Engineering, NFPA/SFPE, Sept. 1988
5. Proulx G. and Fahy R., "The Time Delay to Start Evacuation: Review of Fire Case Studies", Proceedings of the 5th International Symposium, IAFSS, Melbourne 1997.
6. Nelson and MacLennon, "Emergency Movement", SFPE Handbook of Fire Protection Engineering, NFPA/SFPE, Sept. 1988
7. Pauls J., "Movement of People", SFPE Handbook of Fire Protection Engineering NFPA/SFPE, Sept. 1988.

#### (Vic.Chapter News ctd)

This presentation showed that installation, information and equipment supplied with the units allowed for the units to be installed incorrectly, causing a fire hazard. Thanks to Norm Johnson.

Michael Leah from Office Chief Electrical Inspector (OCEI) discussed the operations of his office and presented the investigation of some down light and insulation installation fires. This occurrence is happening in new houses and due to fires in roof areas, damage is severe.

Brian Neal presented the Tiling Timber fire being a large timber warehouse fire which occurred on 30 December 2003. Operation problems included a day of Total Fire Ban, hot weather, poor water supply, many appliances and wind change. Following this talk, there was discussion of the role investigators need to take and the time for large fire investigation.

The committee wish to thank all the presenters for their efforts and presentations.

There were discussions that another training session be held in December. Members will be notified by mail and details will be posted on the website.