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September 7, 2017

Via E-mail

Assistant Commissioner Mark Whybro AFSM
Assistant Commissioner Community Safety
Community Safety Directorate
Fire and Rescue NSW

CC: Jim Hamilton, Chris Lewis, Jeremy Fewtrell, Greg Buckley, Kim Thai, Amanda Ibbotson, Rachel Hughes

FRNSW SAPIRF Tests and Report

Gentlemen and Ladies,

I apologise for the time between my correspondence with you. I have since last correspondence been presenting National Seminars for the Fire Protection Association Australia and currently travelling on the second series.

On the 18th of January, I finally managed to meet with your staff members / researchers Kim Thai and Jeremy Fewtrell at Greenacre to discuss the data obtained from the smoke alarm testing at Londonderry. Unfortunately, I was unable to attend for reasons previously detailed in my email of August 22, 2016.

At the time of the meeting we discussed ignition sources, time in the smoulder and the material that was being smouldered. We looked at the response times of the different technology smoke alarms in various locations in the room of fire origin and smoke alarms remote from the room of fire origin.

The testing was predominantly comparing response times of ionisation, photoelectric and combined photoelectric / heat smoke alarm technology along with temperature and gas toxicity recording. Obscuration was not measured.

My concerns on smoke alarm testing regimes generally were made clear in my September 18, 2016 email to Mark Whybro (copied at the end of this letter). The key concerns were:

1. The specific type of material being smouldered and that it was representative of a real-world smouldering synthetic fire (typical modern furniture and bedding),

2. The energy of the heat / ignition source (representative of the heat energy of a cigarette or high resistance electrical fault),

3. The time in the smoulder (slow enough to replicate the typically most dangerous fires that start at night while occupants sleep),

4. The response of smoke alarms some distance from the smouldering source not in the room of fire origin,

5. The light obscuration in the room of fire origin and in the paths of travel to an exit from sleeping areas at the time of activation of the alarm. (When obscuration levels are high, people are reluctant to travel through the smoke even if a known escape route is beyond the smoke); and

6. The ambient temperature in the test room. The optimal temperature would match that typically found in a residential dwelling in the middle of the night (temperature affects the performance of ionisation alarm activation because it affects the agglomeration rate).

One of the significant deficiencies of current legislation in all Australian States (except Qld & The NT) is that a typical residence may have a single smoke alarm and still meet the deemed to satisfy requirements of the NCC/BCA. Worse is that due to fundamental ignorance, the average person believes that a single 'working' smoke alarm is all they need to provide sufficient time to wake from a fire that develops while they sleep, gather their loved ones and escape to safety. Sadly, we know statistically from Australian fatal fires, the expectations have been ill founded in many cases where there have been 'working' smoke alarms. The question that should be asked following a fire fatality with 'working' smoke alarms is; "Why are there fatalities where working smoke alarms are present?"

When I asked Jeremy and Kim what methodologies were used for ignition and the material that was used for the smouldering fire test, I was advised that a cotton batting material was used around the heat source. I was concerned about the use of the cotton batting (for reasons I will explain below) and asked why it was used. I was told the team was advised to use cotton batting to maintain the smoulder once the heat source was turned off.

At first thought, the use of cotton batting may appear reasonable, especially to those who don't understand the different characteristics of smoke when different materials are smouldered and the relationship between what we term the MIC-X (invisible sub-micron particle) ratio to visible particles (obscuration). The reason it is important is because an ionisation alarm responds effectively to a high MIC-X value of submicron (invisible) combustion particles and a photoelectric alarm responds to the 'visible' particles of smoke (typically larger than 1 micron). Smouldering natural products like wood and cotton give off much higher MIC-X particles to visible particle ratio than smouldering synthetic products do. This is well documented; many scientific papers have been produced on this subject. This was well understood by those who designed the UL 217 smouldering fire tests for smoke alarms in the USA and why the smouldering material in the UL 217 test was changed to a specifically treated clear 'Ponderosa Pine' timber sample. This was because the ionisation alarms would not respond reliably to the presence of visible smoke from smouldering Douglas Fir timber before the required maximum 10% per foot light obscuration was reached in the originating tests.

With this knowledge, I expressed my concern to Kim Thai and Jeremy Fewtrell at our January 18 meeting. I advised them I believed the use of the cotton batting had compromised what was supposed to be tests using smouldering synthetic material. Specifically testing the response of smoke alarms to smouldering synthetic material was critical because we know that is the typical composition of modern furniture and bedding and that smouldering fires that occur at night while residents sleep statistically represent a high number of fire deaths.

The selective response of ionisation alarms has been demonstrated time after time in smouldering tests globally, where they fail to respond to smouldering polyester / polyurethane products but respond well to smouldering cotton. So much so that UL have now developed specific smouldering and flaming polyurethane tests that form part of the revised UL217 testing which will lead to only one combination type of alarm capable of passing the tests and that will be a combination photoelectric / heat alarm. These types of combination smoke / heat detectors have been used for years now in commercial smoke detection applications. This is the field in which I have professionally operated for more than 40 years. These devices are often referred to as 'multi-criteria' or 'multi-sensor' smoke detectors. These commercial smoke detectors have been shown to outperform ionisation-only detectors across a broad range of test fires and do not suffer the nuisance alarm problems that ionisation detectors are notorious for. I noted that one of the smoke alarm types used in the testing was a Brooks combination photoelectric / heat alarm which appeared to perform well.

In a typical electrical fault (overheating conductors or faulty loose connections), the heat source is the fault itself, and in most cases, will sustain the smoulder for extended periods or until the material reaches a flaming stage. The same can be said for smouldering cigarettes left on synthetic material. Mark, in your statement in your September 9, 2016 email below, you mentioned independent review of the Stage 1 report was carried out by six academic experts based at Victoria University (VU). It is difficult to understand why VU experts would have either suggested or remained silent on the use of the cotton batting material when the tests were supposed to represent smouldering synthetic fires. The VU experts certainly would have been aware of the impact it would have on the response times in favour of ionisation alarms. When cotton batting is heated to the point of being able to 'maintain the smoulder' following the removal of the heat source, it must maintain a glowing ember state otherwise it will self-extinguish. Cotton batting in the glowing ember state will emit large quantities of MIC-X submicron particles. The VU peer reviewers would have been aware of this. The use of cotton batting material to maintain the smoulder certainly precludes the FRNSW's SAPIRF tests from being classified as smouldering synthetic fire tests. The use of the cotton batting would compromise conclusions unless this fact and its effects on the results are acknowledged and published as part of the report. It will be inevitably argued by experts that the use of cotton batting for these smouldering fires was a flawed methodology.

The second issue I would like to raise and probably the most significant are the tests that were conducted with the bedroom doors open. This was relating to the response of the sample smoke alarms in the hallways from smoke from the bedroom which was the fire source origin. The test data shown to me in every case revealed the photoelectric smoke alarms and the photoelectric / heat combination alarms in the hallways all responded to the bedroom fire and that the ionisation alarms in the hallway in each case did not respond. This result is significant and typical of what we know of the response of ionisation alarms that are remote from the fire source origin. At the

January 18, 2017 meeting with Jeremy Fewtrell and Kim Thai, I specifically suggested these results were significant because the average Australian home has the smoke alarm(s) positioned in hallways, areas that we would always consider remote from the most likely fire source origin. This response is one of the significant reasons why photoelectric technology provides a superior early warning. Is it intended the SAPIRF report will highlight this?

We had an agreement for me to be provided with a copy of the final report before it was to be made public. That has not yet occurred. I have seen a preliminary one-page summary report that the New Zealand Fire Service used in a Coronial enquiry in New Zealand where a Grandmother and Grandchild died in a public housing residential occupancy fitted with multiple ionisation smoke alarms. Some of the information which I was privy to under an NDA with FRNSW was disclosed in this report. The conclusions stated and implied were in my view premature. The report did not provide adequate detail, especially from the testing where the smoke alarms were not in the room of fire source origin and the fact the conclusions appear to rely on the use of cotton batting which unequivocally compromised the test results. There was also no reference to the unacceptably high disconnection rate of ionisation alarms due to their inherent false alarm problem. This is significant because we know that statistically in the range of 20% in higher socioeconomic residences, to 40% in public housing, of ionisation alarms are disconnected within two years of installation by consumers intolerant of the nuisance alarm rate.

What should be of considerable concern to all of us is the data on the performance of ionisation alarms in the smouldering fire smoke sensitivity tests that have been conducted by the CSIRO since 1993 under AS 2362.17. This test is required under AS 3786 – 1993. These tests are carried out on all smoke alarms Agency Listed to AS 3786 e.g. through the CSIRO's Activfire & SAI Global Listing schemes. In February 2006, the CSIRO's representative on Standard Australia's committee FP002 provided AS 2362.17 scientific test data which consistently shows an inability of all ionisation smoke alarms to respond reliably to the presence of visible smoke. Clause 2.1 of AS3786-1993 states, "The smoke alarm shall be designed to respond reliably to the presence of smoke."

The AS 2362.17 smoke sensitivity tests conducted in a specially built smoke test room, subject all smoke alarms to the smoke from a piece of smouldering Masonite (composite timber) on top of a 3.6kw element in a fast smouldering fire which is concluded in 17 minutes. Apart from the fast nature of the forced smoulder in this test, such a fire type is reasonably representative of a real-world smouldering composite timber fire. Since 1993, SSL / CSIRO scientific test data shows that typically all ionisation alarms do NOT respond to the smoke until the light obscuration in the test room is more than three times (40 to 60% light obscuration per metre) the level at which typical photoelectric smoke alarms respond (8 to 12% light obscuration per metre). Ionisation alarms typically respond in the 16 to 17-minute range whilst photoelectric smoke alarms typically respond in the 6 to 7-minute range. Those of us who understand smoke characteristics know that if the smoulder time in this test was slowed down, the results would be even more damning of the ionisation alarm performance.

Considering what we know and have expressed above, I became concerned about what appeared to be the premature / early release of preliminary test results used by the New Zealand Fire Service in a NZ coronial enquiry. This preliminary report was made available to me following the NZ enquiry. The preliminary report contained selective information from the tests in what I have concerns are conclusions using incorrect testing techniques (cotton batting). If the preliminary

report obtained by the New Zealand Fire Service is in fact representative of the conclusions you intend to release, it will be contradictory to all other tests where smouldering synthetic material is used e.g. The NIST 1455 HSAT report and their later conclusions to the Boston City Council enquiry, the new smouldering polyurethane test developed by UL and the series of three separate tests conducted by the Building Research Association of New Zealand circa 2006 -2014. Failure to recommend photoelectric over ionisation alarms in residential occupancies is contrary to the above referenced tests and the current AFAC, FRNSW (since 2006) & FPAA positions. Since 2004, AS 1670.1 requires photoelectric smoke detection in all sleeping areas and paths of travel to exits of the buildings to which it applies

Further concerns arise from a recent television interview with Channel 9's Karl Stefanovic and a FRNSW representative, where when questioned by Karl, the FRNSW person stated that the type of smoke alarm did not matter as long as it complied with the Australian Standard. This is a recent change in position by FRNSW; I hope this is not based on what will be alleged as flawed testing methodologies used during the SAPIRF tests.

I strongly suggest that before releasing the final SAPIRF report that you submit this study for peer review by independent experts at places that have conducted significantly more research than Australia such as Thomas Cleary, US National Institute of Standards and Technology (NIST) and David Mills and Paul Lloret, from Underwriters Laboratories in the USA. Additionally, you could solicit the support of individual experts such as Chief Joseph Fleming of the Boston Fire Service (who has assisted FRNSW and AFAC in the past) and Dr Vyto Babrauskus who is currently doing research with NIST and UL. A failure to do this could potentially cause the promulgation of misinformation and put lives at risk.

Given the level of involvement that VU had in the assistance of setting the test protocols with FRNSW, they certainly could not be considered as independent peer reviewers.

Once the report is finalised I would be happy to assist FRNSW with developing a policy for regulatory reform for smoke alarm installations in NSW residences as would I am sure your Queensland counterparts.

As I have signed the Confidentiality Agreement, please forward the final SAPIRF report before publication so I may review it as agreed.

Yours faithfully,
Fire and Safety Technologies Pty. Ltd.

David P. Isaac
Director

About the author

David was the recipient of the FPAA 2016 A. V. Viscogliosi award recognising excellence for outstanding service to the Fire Protection Industry.
David is a member of the Australian Standards Committee FP002 – *'Fire Detection, Warning, Control & Intercom Systems'* which writes the suite of Australian Standards on fire detection and alarm systems.
David is also a member of Standards Sub-Committee ME-062 advising the committee on the electrical performance and compliance issues for AS 1668.1 'The use of ventilation and air-conditioning in buildings Part 1: Fire and smoke control in multi-compartment buildings' and AS 4428.7 'Fire detection, warning, control and intercom systems—Control and indicating equipment Part 7: Air-handling fire mode control panel'.
David is also a member of the Fire Protection Association Australia (FPAA) Technical Advisory Committee TAC/2, a former FPAA representative to Australian Communications Industry Forum Cabling Advisory Group (ACIF/CAG) which writes the telecommunications industry cabling Standards.
David is an Australian Communications and Media Authority (ACMA) Registered cabler and a Licensed Electrical Contractor.
David was a member of the NSW Rural Fire Service from 1978 to 1989.
David has more than 45 years' experience in electrical systems design installation and commissioning for building services, heavy industrial installations and essential services systems including fire detection systems.
David holds Post Trade electrical engineering Certificates in Building Services and Heavy Industrial installations.
In the last 30 years David has worked in private consulting, advising corporations on fire safety measures and held senior management roles for major international fire detection system manufacturers.
In the last 18 years David has been an active participant in Fire Industry Associations and the Standards writing processes in Australia.
David is a consumer advocate and has published several articles on the imperative of uniformity and Code compliance of life safety systems.
E-mail: david.isaac@firest.com.au

From: Mark Whybro [mailto:Mark.Whybro@fire.nsw.gov.au]
Sent: Thursday, 22 September 2016 8:17 AM
To: David Isaac
Cc: Chris Lewis; Greg Buckley; Jeremy Fewtrell; Jim Hamilton; Amanda Ibbotson; Rachel Hughes; Greg Mullins
Subject: RE: Fire & Rescue NSW Research

Good morning David,

Thank you for your comprehensive e-mail and clarifications – much appreciated. We are always looking for ways to improve, so would certainly appreciate the opportunity to meet and hear your thoughts on the research plan and methodology. I'd appreciate your advice on whether you'd prefer the 10th, 11th or 12th of October, and a convenient time so that we can schedule a meeting. This would assist ensuring Jim Hamilton (currently Acting Commissioner), SUPT Jeremy Fewtrell (Manager FIRU) and Kim Thai (FIRU Research Officer) are also able to attend.

I'll await your further advice.

Kind regards

From: David Isaac [mailto:david.isaac@firest.com.au]
Sent: Sunday, 18 September 2016 10:58 PM
To: Mark Whybro <Mark.Whybro@fire.nsw.gov.au>
Cc: Chris Lewis <Chris.Lewis@fire.nsw.gov.au>; Greg Buckley <Greg.Buckley@fire.nsw.gov.au>; Jeremy Fewtrell <Jeremy.Fewtrell@fire.nsw.gov.au>; Jim Hamilton <Jim.Hamilton@fire.nsw.gov.au>; Amanda Ibbotson <Amanda.Ibbotson@fire.nsw.gov.au>; Rachel Hughes <Rachel.Hughes@fire.nsw.gov.au>; Greg Mullins <Greg.Mullins@fire.nsw.gov.au>
Subject: RE: Fire & Rescue NSW Research

Mark,

Thanks for your response on behalf of Greg. Again, I have been interstate, so I apologise for my late response.

I don't doubt the rigour of the tests, it is the technical application of the methodology I have always been concerned about and this comes from years of examination of global test methods and their relevance to real world fires.

I was sent a matrix in May that identified smouldering ignition sources as 'Cartridge heaters' and unfortunately being unable to attend, I was unable to determine how that was to be achieved, or even to observe the methods. For example, the rated power of the heater, the contact area, the smouldering time and the position of the SA relative to the fire.

I note the matrix you attached differed in that it referred to soldering iron ignition source which appears to make more sense; but again, the devil is in the detail e.g. the rated power of the soldering iron (to represent a very slow smoulder), position relative to the smoke alarms etc. My concerns have always been with smouldering tests, the material smouldered, the temperature of the ignition source, and the time the smoulder is allowed to develop. It is the very slow smouldering electrical and cigarette fires which ironically appear to be the most deadly if allowed to develop undetected while occupants sleep. As we all know from bitter experience it is too late once the fire reaches the flaming stage when occupants are sleeping and they are relying on typically a single smoke alarm usually NOT in the room of fire origin to wake them in time to effect an escape for ALL occupants.

My inability to attend Stage 2 was regrettable, even though I conversed with Jeremy on a couple of occasions, when I was attempting to sort out my schedule.

You may not be aware that the CSIRO smoke alarm testing under AS 2362.17 actually demonstrates how dangerous ionisation alarms are in their failure to respond to smouldering fires. The AS 2362.17 Agency Listing test is a smouldering test using a piece of Masonite strapped on to a **3.6kw** element. The test is over in **only 17 minutes** (definitely NOT a slow smouldering test) by which time the sample ionisation alarms must have activated. By the 17 minutes, the test room is full of smoke down to 2.7 metres below the ceiling (below normal residential ceiling height) by the time the ionisation alarms activate. At the point at which the ionisation alarms active, the obscuration in the test room is typically between 48 to 62% obscuration per metre. This is 3 to 4 times higher than the required response for photoelectric smoke alarms in the same test. (Note photoelectric smoke alarms activate at typically between 8 to 12 % obscuration per metre in around 7 minutes in exactly the same test). The ionisation alarms are allowed to pass the test because the obscuration level is not the pass criteria even though the 'elephant in the room' should have caused considerable concern to those conducting the tests. I have been personally advised by an engineer who has carried out numerous of these tests that if the smoulder was slowed down to half the rate, it is likely the ionisation alarms may not activate at all. I allege this CSIRO Scientific test proves beyond doubt the ionisation alarm is NOT fit for purpose. I have made this statement publicly on many occasions including my testimony to the Federal Senate enquiry and my testimony to the Queensland Government enquiry.

A similar result occurs in the UL 217 tests (USA) where specially selected and treated 'White Pine' (Ponderosa Pine) is super-heated to a temperature just below auto ignition on a similar sized electrical heating element and this gives off

just the right sub-micron particle size combustion product to eventually activate the ionisation alarm, but again at an obscuration level approaching 30% per metre.

The EN54-7 test fires (now used in the 2014 AS 3786) also allow ionisation type alarms to activate at a very high obscuration rate and pass the test.

There is a long and detailed history behind all of these tests.

So we know that ionisation alarms are very selective to the type of product that is smouldering (synthetic products are worse), the temperature of the smouldering fire and the amount of thermal buoyancy. The particles must be passing through an ionisation chamber at a reasonable rate otherwise the alarm may initially operate and then go silent and there are plenty of reported examples of this phenomena.

So my concerns definitely lie in the testing in that it represented a true slow smouldering fire, the type that occurs when residents are sleeping and may be caused by cigarettes and electrical faults etc, because we know that when the fire develops to the flaming stage the performance between the two types of technologies is only seconds when they are installed in the room of fire origin. When the alarms are installed remote from the room of fire origin, the ions are typically much slower to respond than photoelectric regardless of the fire type.

I would be happy to meet with you and Jeremey; may I suggest 10th, 11th or 12th of October as I am again Interstate each week prior to those dates and interstate and overseas the three weeks after.

Regards,
David P. Isaac
Manager
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From: Mark Whybro [mailto:Mark.Whybro@fire.nsw.gov.au]
Sent: Friday, 9 September 2016 6:06 AM
To: David Isaac
Cc: Chris Lewis; Greg Buckley; Jeremy Fewtrell; Jim Hamilton; Amanda Ibbotson; Rachel Hughes
Subject: Fire & Rescue NSW Research

Good morning David,

I write on behalf of Commissioner Greg Mullins, who is currently on leave.

Thank you for your email and interest in FRNSW's ongoing smoke alarm research. This is certainly an area that remains topical, especially with the recent changes to Queensland's smoke alarm legislation.

In relation to the research's methodology, I can assure you that FRNSW followed a thorough and scientifically rigorous testing program for Stage 2 of the program. The testing matrix used for the research was developed to include a comprehensive range of likely ignition scenarios in a residential setting. It incorporated deliberate and accidental ignition scenarios, a range of locations within the residence, as well as a mix of flaming and smouldering fires.

The testing matrix used in the Stage 2 research is attached to this email. It includes 27 different ignition scenarios, with each being repeated three times to ensure the statistical validity of the data. Please note the testing matrix was developed following an independent review of the Stage 1 report by six academic experts based at Victoria University.

I am advised that similar information was also provided to you in email correspondence that was sent to you in May 2016 inviting you to attend the latest round of testing. Providing this information to you demonstrates that FRNSW was and continues to be open and upfront with you about this research work.

The tests were conducted in a very professional manner with a comprehensive data capture system recording all details. It was unfortunate you were unable to RSVP to our repeat invitations for you to attend Stage 2 testing, meaning you did not observe the quality of this work first-hand.

As Commissioner Mullins is on leave for a number of weeks, I would like to meet with you and provide further information about the design and conduct of the Stage 2 research tests. Superintendent Jeremy Fewtrell, FRNSW's Manager Fire Investigation & Research, oversaw the conduct of the tests and may also join us.

I'd appreciate if you could please advise any suitable dates to meet so details can be confirmed.

Kind regards

Assistant Commissioner Mark Whybro AFSM
Assistant Commissioner Community Safety
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