



**Australian Government**

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**Australian Transport Safety Bureau**

**Aviation Safety Investigation Report  
200305496**

**The effectiveness of the fire fighting  
arrangements for Bankstown Airport, as they  
affected transport safety on 11 November 2003**

## FACTUAL INFORMATION

### Accident sequence

On 11 November 2003, a Piper Seneca, registered VH-CTT, was seen to diverge right during a go around from runway 11 Right at Bankstown Airport, NSW. It maintained a constant height above the ground and; when about halfway along the runway, the aircraft's nose lifted and it banked steeply to the right before impacting the ground in a near vertical nose-down attitude. A student pilot in the left seat and an instructor pilot in the right seat were the only occupants.

A fire commenced when the aircraft impacted the ground or shortly after the impact. The fire intensified after the aircraft came to rest. The main cabin door, located over the right wing, separated from the aircraft during the accident. The instructor pilot vacated the aircraft through that opening about 30 seconds after the aircraft came to rest. The student pilot was fatally injured. The instructor pilot received severe burns and was treated in hospital for three and a half weeks before succumbing to those injuries.

**Figure 1: Post-impact dust and fire**



### Effectiveness of fire fighting services

On 1 December 2003, the Minister for Transport and Regional Services signed an Instrument of Direction to the Australian Transport Safety Bureau (ATSB). That instrument directed the ATSB to 'investigate the effectiveness of the fire fighting arrangements for Bankstown Airport, as they affected transport safety at Bankstown Airport on 11 November 2003'. Effectiveness is defined as 'serving to effect the purpose; producing the intended or expected result'.<sup>1</sup> The instrument was issued to the ATSB on 15 December 2003.

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<sup>1</sup> Macquarie Dictionary (revised third edition), The Macquarie Library, NSW, 2003

## International requirements

Australia is a signatory to the Convention on International Civil Aviation (Chicago Convention). This agreement sets out standards and recommended practices (SARPs) for signatory States. However, Australia has notified the International Civil Aviation Organization (ICAO) of a difference from those SARPs for national rescue and fire fighting services. The difference states that ‘rescue and fire fighting services to Annex standards are not available at some international and international alternative aerodromes’. Bankstown Airport is not an international or an international alternative aerodrome.

The *ICAO Airport Services Manual*, Part 1, Rescue and Fire Fighting (3<sup>rd</sup> Edition 1990) states in Chapter 2, Paragraph 2.7.1 that the ‘operational objective of a rescue and fire fighting service should be to achieve response times of 2 minutes and not exceeding 3 minutes to the end of each runway in optimum conditions of visibility and surface conditions, as well as any other part of the movement area’.

Paragraph 2.7.2 states that ‘to ensure continuous agent application at the appropriate rate, any other rescue and fire fighting vehicles required to carry the amounts of extinguishing agents specified in [airport category<sup>2</sup>] Tables 2-2 and 2-3 [of Paragraph 2.3] should respond no more than 60 seconds after the first responding vehicle’. Paragraph 2.3, titled ‘Amounts of Extinguishing Agents’, lists these water, foam and complementary agent specifications and the discharge rates.

Table 2-2 details the minimum usable amounts of extinguishing agents for aqueous film forming or fluoroprotein foam. Table 2-3 details the minimum usable amounts of extinguishing agents for protein foam. Paragraph 2.6.1 states that ‘the quantities of the various extinguishing agents to be provided in the rescue and fire fighting vehicles should be in accordance with the airport category tables’.

Based on the 2002 Bankstown Airport aircraft movement data, for the purposes of aerodrome rescue and fire fighting services (ARFFS), Bankstown Airport would have been a Category 3 aerodrome.<sup>3</sup> That category aerodrome would normally require a minimum of one rescue and fire fighting vehicle.<sup>4</sup>

The ICAO standard for aerodrome rescue and fire fighting services is based on the following statistics and parameters:

- about 70 per cent of aircraft crashes occur on aerodromes
- of those that occur on aerodromes, 90 per cent are survivable
- people on board a major aircraft that is involved in fire can survive up to four minutes

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<sup>2</sup> The airport category for ARFFS should be based on the dimensions of the aeroplanes using the airport as adjusted for their frequency of operations.

<sup>3</sup> Assuming Hawker Siddley 748 (MAUW 20200 kg) as largest aircraft using the aerodrome but with less than 700 movements per month, the category can be reduced by 1 (from Cat 4 to Cat 3).

<sup>4</sup> ICAO Annex 14 – Aerodromes Chapter 9.2.23 recommends a minimum of one vehicle for an aerodrome classified Category 1 to 4.

- intervention of an aerodrome rescue and fire fighting service within the four minutes can extend that time limit allowing people on board to be rescued.<sup>5</sup>

## National regulations

Safety regulation of civil air operations in Australia and the operation of Australian aircraft overseas is the primary function of the Civil Aviation Safety Authority (CASA).

In the early 1990s a decision was made to remove ARFFS at some aerodromes. Services were removed from all general aviation airports (GAAP)<sup>6</sup> following consultation with the aviation industry and the aerodrome operators. Rescue and fire fighting services were withdrawn from Bankstown in 1991.

CASA safety regulations in relation to ARFFS are contained in *Civil Aviation Safety Regulation (CASR) Part 139 Subpart H - Aerodrome rescue and fire fighting service*. CASR Subpart 139 H was adopted on 26 June 2002, for commencement on 1 May 2003, following industry consultation conducted since March 2000.<sup>7</sup>

It was intended that Part 139 Subpart H would place an obligation on aerodrome operators to provide an ARFFS, for aerodromes from, or to, which an international passenger air service operated, and any domestic aerodrome through which more than 350,000 passengers passed on air transport flights during the previous financial year. This standard was aimed at minimising the risk for the greatest number of passengers. However, subsequent actions following the tabling of a disallowance motion in Parliament removed both the obligation for anyone to provide an ARFFS or requiring the provision of an ARFFS. The Department of Transport and Regional Services (DOTARS) has taken action to re-insert establishment criteria in the CASRs.

Of Australia's 600 aerodromes, Airservices Australia provides ARFFS at eight capital city and nine regional aerodromes<sup>8</sup> in line with the Government's policy of providing ARFFS at aerodromes exceeding 350,000 passengers in the previous financial year, or that have international air services.<sup>9</sup> There is nothing precluding an airport operator of an airport that falls outside the criteria, should they choose to, from providing a non-ARFF service at their airports, or from requesting a certified supplier to provide an ARFFS to an appropriate standard.

The Manual of Standards Part 139 H – *Standards Applicable to the provision of Aerodrome Rescue and Fire Fighting Services*, states that all operational ARFFS staff must comply with CASA standards that require a current qualification and certificate of competency commensurate with the functional role at a specific location.

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<sup>5</sup> House of Representatives Standing Committee on Transport and Regional Services report, *Regional Aviation and Island Transport Services: Making Ends Meet*, December 2003.

<sup>6</sup> Includes Parafield SA, Jandakot WA, Camden NSW, Moorabbin Vic., and Archerfield Qld.

<sup>7</sup> Information about the consultation process is available from the CASA website [www.casa.gov.au/avreg/newrules/casr/139h.htm](http://www.casa.gov.au/avreg/newrules/casr/139h.htm)

<sup>8</sup> Airservices Australia data available at [www.airservicesaustralia.com/services/ps7/contracts2.asp](http://www.airservicesaustralia.com/services/ps7/contracts2.asp)

<sup>9</sup> House of Representatives Standing Committee on Transport and Regional Services report, *Regional Aviation and Island Transport Services: Making Ends Meet*. The report is available at [www.aph.gov.au/house/committee/trs/aviation/report/contents.html](http://www.aph.gov.au/house/committee/trs/aviation/report/contents.html)

Those competencies include casualty assistance, emergency care, emergency life support techniques and how to operate life-support equipment.<sup>10</sup>

The Department of Transport and Regional Services collects aviation statistics on passenger movements at Australian aerodromes. However, the data gathered is limited to passengers from international, domestic and regional airline scheduled air transport flights at 94 aerodromes. That data did not include passengers carried on charter or other non-scheduled air transport flights, and it did not include those aerodromes that received less than 7,000 revenue passenger movements in 2002–03. Bankstown Airport does not have scheduled air transport passenger flights and is not an international airport.<sup>11</sup> The passenger data from Bankstown and other GAAP aerodromes is excluded from the DOTARS annual statistical publication.

The Aeronautical Information Publication En Route Supplement Australia (ERSA) details the ARFFS for each aerodrome listed. The Bankstown ERSA entry has no ARFFS detailed.

#### Parliamentary activities

On Monday 1 December 2003, the House of Representatives Standing Committee on Transport and Regional Services tabled its report *Regional Aviation and Island Transport Services: Making Ends Meet*. The report follows an inquiry into commercial regional aviation services in Australia and transport links to major populated islands.

The inquiry looked at the cost of aviation [aerodrome] rescue and fire fighting services, and the conditions under which these services are now provided following industry concerns. It found that there was some disagreement in the evidence about the justification for fire fighting and rescue services being provided at aerodromes. The cost of providing the service is determined by the equipment needed to meet the standards for delivering water and foam within an aerodrome during a call-out. At some aerodromes around the world, and in Australia, it has been found to be more cost effective for aerodrome fire fighting and rescue services to be provided by the fire service serving the local community. At Bankstown, where there are no scheduled passenger services, the aerodrome fire fighting and rescue service is provided by the New South Wales Fire Brigades.

The inquiry found that there were two issues to be considered:

- the provision of rescue and fire fighting services to aerodromes with limited numbers of passenger landings
- whether these services are provided by Airservices Australia or by local fire services.

The committee report contained the following recommendations:

- The Department of Transport and Regional Services and Airservices Australia introduce a universal service charge for aerodrome rescue and fire fighting

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<sup>10</sup> Certificate II and III level of Australian Fire Competency.

<sup>11</sup> Data on the number of passengers using non-scheduled services such as charter flights is not available, as indicated by the preceding discussion.

services at regional aerodromes to reduce the wide disparity in the charges for those services and to reduce the overall impact of the charges on regional aviation costs;

- The Department of Transport and Regional Services and Airservices Australia form a working group with key stakeholders (such as the relevant local government associations, town planning and standards bodies) to advise on the strategic and optimal co-location of fire fighting services; and
- Airservices Australia provide the initial aerodrome rescue and fire fighting equipment and crew training, at no cost, to communities where fire fighting services become co-located.

The Government is currently considering its response to this comprehensive report.

#### Air traffic control response to the emergency

On the day of the accident involving VH-CTT, the air traffic control tower was staffed by two controllers, one occupying the aerodrome control (ADC) position and the other at the tower coordinator (COORD) position.<sup>12</sup> Both controllers saw the Seneca go around and diverge from the runway. When it was apparent that there was likely to be an accident they commenced emergency response procedures.

The ADC activated the crash alarm at 1247:25 Eastern Summer Time, however he incorrectly selected the console power switch. The accident was estimated to have occurred at 1247:30. The ADC re-selected the console power switch and power was restored at 1247:50. At 1247:55, the Bankstown Tower Coordinator/Surface Movement controller notified the New South Wales Fire Brigades of the accident.

The ADC worked at both Camden and Bankstown control towers. The location of the crash alarm and console power switch on the consoles were transposed in the respective towers.

Airservices Australia advised that, where an ARFFS is provided, that service is required to monitor landings and takeoffs from a fire control centre (FCC). A crash alarm can be activated from an FCC that may result in an enhanced response to an accident. Airservices also advised that ARFFS response times can be significantly less than required in the CASRs at smaller aerodromes similar to Bankstown.

#### Personnel response to the VH-CTT accident

Very soon after the instructor had vacated the aircraft, personnel working near the museum (located within the aerodrome), and from a factory complex adjoining the aerodrome, attacked the fire using hand-held fire extinguishers. One person from the factory, who was trained in fire fighting as part of the factory's emergency response team (ERT), administered first aid to the instructor and directed other staff from the factory to lay out a fire hose from the ERT equipment trailer. At least 12 fire extinguishers and the hose were used on the aircraft fire before the fire brigade arrived.

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<sup>12</sup> The controller at the coordinator position was managing both coordinator and surface movement control functions.

**Figure 2: Aircraft accident site**



### New South Wales Fire Brigades (Brigades)

The Brigades' objective in an emergency (24 hours a day, 7 days a week), in the greater Sydney area, which included Bankstown Airport, was to attend the site of an emergency incident within 10 minutes from the time of a call on 90% of occasions.

Fire fighting units from Bankstown, Revesby and Chester Hill were dispatched at 1248:53 with a rescue unit from Liverpool at 1249:19.

At 1256:49 the Bankstown Urban Pumper unit arrived at the aerodrome. That unit was delayed in gaining entry to the aerodrome as the safety officer, responsible for managing access to the airside of the aerodrome, was escorting an ambulance to the accident site as the unit arrived at the assembly point. Consequently, the unit was delayed outside the fence securing the aerodrome movement area. It was normal practice for a safety officer to escort non-aerodrome personnel and vehicles onto the aerodrome movement areas. At 1258, the crew reported by radio that they were, '...making way to the crash site'.

That first unit, at the accident site, was followed by other units at 1258:02 (the Revesby Rescue Monitor unit), at 1258:56 (Chester Hill Urban Pumper unit) and at 1300:34 (Liverpool Rescue unit).

The Brigades assumed control of the site, extinguished the fire and requested aerodrome and local industry personnel who had commenced to fight the fire with portable fire extinguishers and the 38 mm fire hose, to vacate the site for their own safety. Only two of the four units at the scene were used. The units returned to their respective stations at 1417:00.

Data provided by the Brigades indicates that 9 minutes is the average time for a unit to travel from Bankstown, Revesby, Chester Hill or Liverpool stations to the centre of Bankstown Airport based on the Brigades' planned road speed of 42 kph.

During 2001–02 and 2002–03, the Brigade responded within 10 minutes to 86% and 88% of calls within Bankstown Airport respectively. Of the 22 calls in 2001–02, two were in response to an actual fire/explosion and of the 26 calls in 2002–03, three were in response to an actual fire/explosion. The average response time in 2001–02 was 8 minutes 18 seconds and in 2002–03 it was 7 minutes 18 seconds.

Brigades' data for the responses to the 1,992 calls during 2002–03 within the suburbs of Bankstown, Revesby, Chester Hill or Liverpool (exclusive of aerodrome calls) indicate an average response time of between 5 and 7 minutes.

### Transport mode safety comparisons

In 2002, the ATSB issued a discussion paper on *Cross Modal Safety Comparisons*.<sup>13</sup> The purpose of the paper was to look at the relative safety of various transport modes.

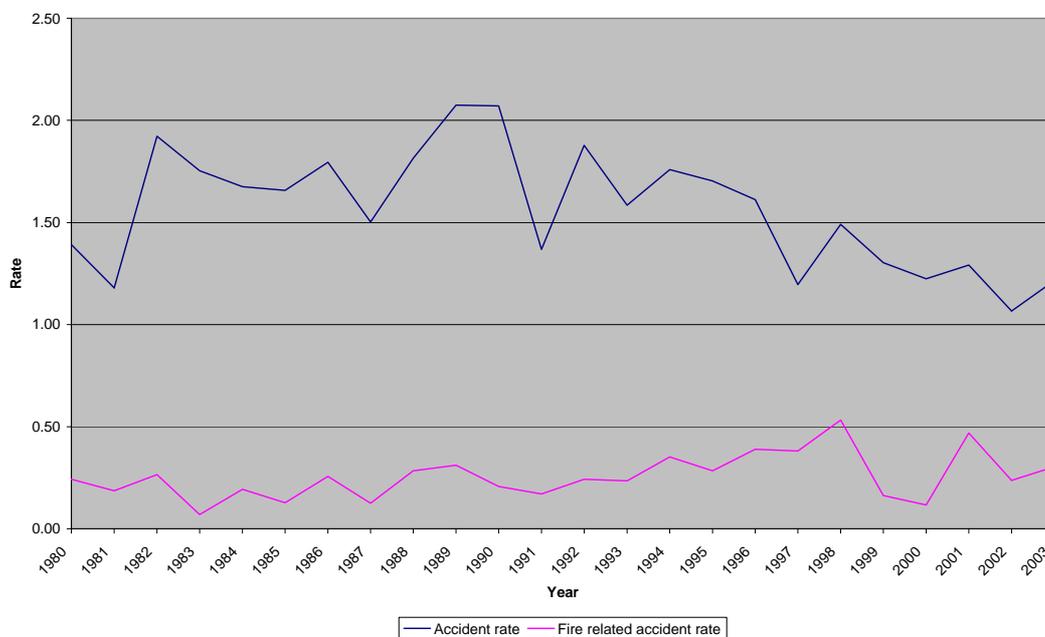
The study found that while relative safety rates between different transport modes are difficult to compare, based on the best available data, high capacity regular public transport air travel (involving transport category aircraft) is the safest form of transport, while general aviation is significantly less safe than car travel.

### ATSB accident database

A review of the Bureau's aircraft accident database<sup>14</sup> between 1980 and 2003 was conducted to:

- ascertain the significance of the withdrawal of ARFFS from general aviation airports in 1991
- establish the number and location of fire related fatal general aviation (GA) accidents during the period.

**Figure 3: Fire related fatal general aviation aircraft accidents per 100,000 flying hours**



<sup>13</sup> Available at [www.atsb.gov.au/public/discuss/cross\\_modal.cfm](http://www.atsb.gov.au/public/discuss/cross_modal.cfm).

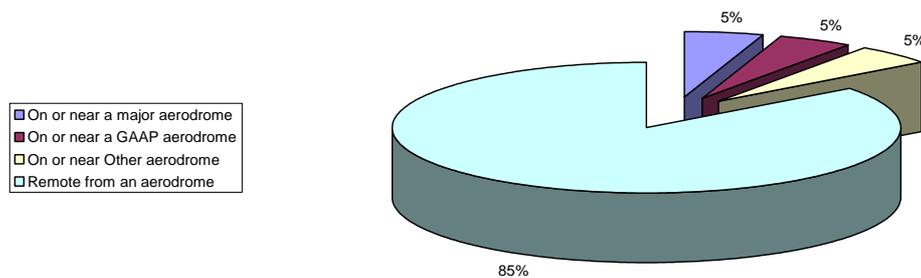
<sup>14</sup> The review excluded non-powered general aviation accidents (gliding, parachuting and paragliding) that would not be subject to in flight or post impact fire.

The data revealed that there were 638 fatal GA aircraft accidents and of those, there were 106 in which the aircraft and the occupants were involved in a post-impact fire. The data was normalised and a rate per 100,000 general aviation flying hours was calculated to enable a comparison of the number of fire and non-fire related accidents.

The comparison revealed that there was no statistically significant change in the fire related accident rate following the withdrawal of the ARFFS from general aviation aerodromes in 1991.<sup>15</sup> It also shows that the overall accident rate has reduced over the period.

Between 1980 and 1991, there were 41 fatal, fire related, accidents. The majority of those accidents occurred in areas remote from aerodromes served by an ARFFS. Fire related accidents occurred near Bankstown, Perth and Essendon aerodromes and they were served by an ARFFS.

**Figure 4: Location of fire related fatal GA accidents, 1980 to 1991**

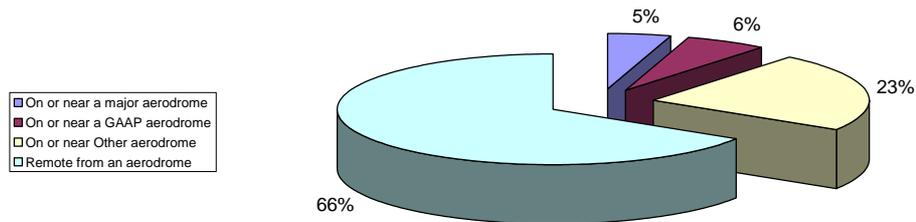


Between 1992 and 2003, there were 65 fatal, fire related, GA accidents. The majority of those accidents occurred in areas remote from aerodromes/airports served by an ARFFS but there was an increase in the number of accidents that occurred near regional centre aerodromes and other localities. Fire related fatal accidents occurred at Bankstown, Camden, Moorabbin and Jandakot general aviation aerodromes, plus near Alice Springs, Ballarat, Bundaberg, Canberra, Ceduna, Coffs Harbour, Goulburn, Groote Eylandt, Hamilton Island, Jerilderie, King Island, Mareeba, Melbourne, Mount Gambier, North Stradbroke Island, Tamworth and Tindal aerodromes.

<sup>15</sup> Poisson regression was used. Relative rate=1.48 for period 1992-2003 vs 1980-1989, p>.07, 95% CI 0.98 and 2.24.

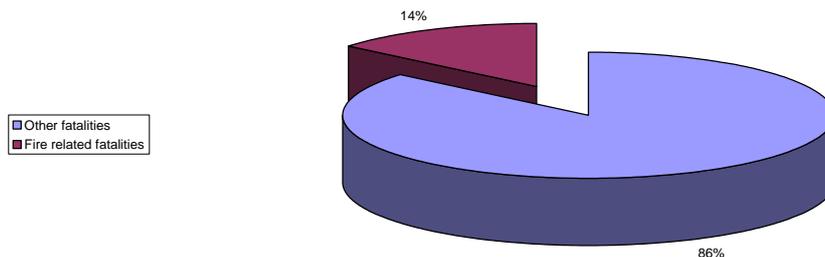
Canberra, Alice Springs, Launceston and Tindal<sup>16</sup> aerodromes were served by an ARFFS.

**Figure 5: Location of fire related fatal GA accidents, 1992 to 2003**



Between 1980 and 1991, there were 651 fatalities<sup>16</sup> resulting from general aviation accidents. Of those fatalities, 91 were from fire related accidents and were assessed to be due to either fatal impact injuries or burns from the ensuing fire.

**Figure 6: General aviation accident fatalities, 1980 to 1991**

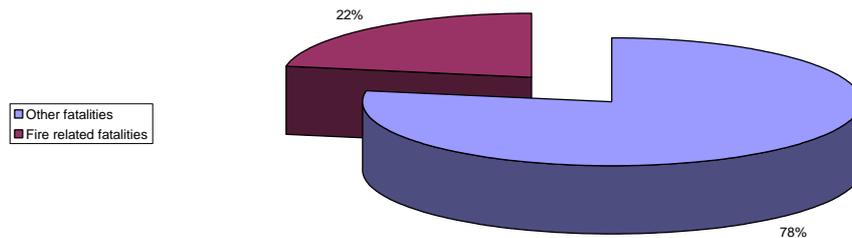


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<sup>16</sup> Tindal airport was served by an Australian Defence Force ARFFS.

Between 1992 and 2003, there were 542 fatalities resulting from general aviation accidents. Of those fatalities, 120 were from fire related accidents and were assessed to be due to either fatal impact injuries or burns from the ensuing fire.

**Figure 7: General aviation accident fatalities, 1992 to 2003**



There was a reduction in the number of fatalities in the 1992 to 2003 period compared to the period from 1980 to 1991. But the number of fatalities in fire related accidents increased as a proportion of the overall fatalities for the 1992 to 2003 period. There was also a slight increase, during the 1992 to 2003 period, in the number of multiple fire related fatalities compared with all fire related fatalities.<sup>17</sup>

The accidents involved either twin or single-engine aircraft with a maximum allowable take-off weight less than 5,700 kg and that used aviation gasoline (AVGAS) or propane as fuel.

Other than balloons, and some smaller aircraft, the majority of the aircraft were constructed with a single aluminium outer layer on the fuselage that provides less resistance to heat and flames than the majority of transport category aircraft used in passenger operations. The post-impact fires were intense due to the availability of a volatile fuel and the disruption of the aircraft structure during the impact sequence.

Information from recent accidents indicates that surviving occupants evacuated the respective aircraft in less than 90 seconds of it coming to rest following ground impact.

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<sup>17</sup> Changed from 43% of all fire related fatalities in 1980 to 1991 period to 51% in the 1992 to 2003 period.

## Resistance of aircraft to burning

The US Federal Aviation Administration has conducted research and tests to establish the resistance of transport category aircraft structures to the penetration of post-crash fuel fires into the fuselage (burn-through). The burn-through resistance of the aluminium skin of an aircraft is between 30 and 60 seconds. Tests using improved thermal-acoustical material show significant improvements over insulation blankets currently in use, which fail within 2 minutes. The tests also found that the means of attaching thermal-acoustical material to the aircraft structure had a critical effect on the effectiveness of the material.<sup>18</sup> While work is under way to improve the survivability during an accident, the focus is on transport category aircraft.<sup>19</sup>

## ANALYSIS

The current ARFFS arrangements at Bankstown Airport do not comply with ICAO SARPS, nor are they required to by Australian regulations or policy. Those regulations and Government policy do not require an ARFFS to be provided for operations at Bankstown Airport and consequently the NSW Brigades provide a similar level of service to both the general community and the aerodrome.

Of the 94 aerodromes for which passenger data about scheduled air transport services is gathered, 77 have a similar level of ARFFS to that provided to Bankstown Airport and the other GAAP aerodromes across Australia.

In response to the accident notification, the first Brigades unit arrived about 9 minutes after notification, which met its goal of providing assistance within 10 minutes of notification, 90% of the time. While in the last 2 years it has only achieved 86% and 88% within 10 minutes, the average response time has improved by 1 minute (2002–03 compared with 2001–02). The instructor pilot vacated the aircraft through the main cabin door opening about 30 seconds after the aircraft came to rest. However, due to the severity of his burn injuries, he died in hospital three and a half weeks later.

An earlier fire fighting response that met the ICAO standard, would in some situations, enhance occupant survivability due to the availability of rescue and first aid prior to the arrival of ambulance services. However, given the severity of the injuries sustained by the instructor and student, and the fact that first aid was provided very soon after the instructor vacated the aircraft, the provision of an ICAO standard fire fighting service is unlikely to have improved the survivability of the accident.

On seeing that there was likely to be an accident, the ADC activated the wrong switch due to the transposition of the location of the crash alarm switch in the Camden and Bankstown tower consoles. The incorrect selection of the console power switch resulted in a 30 second delay in the notification of the accident to emergency services. That delay may have had some bearing on a response if an ARFFS had been located at Bankstown Airport. However, under the circumstances the delay was considered to be not significant in light of the overall time required for the Brigades' units to reach the accident site.

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<sup>18</sup> US Department of Transportation Federal Aviation Administration, *Full-Scale Test Evaluation of Aircraft Fuel Fire Burnthrough Resistance Improvements*, January 1999.

<sup>19</sup> C P Sarkos, *Future Trends in Aircraft Fire Safety R&D*, November 1998.

Similarly, the delay experienced by the first Brigade unit in gaining immediate entry to the accident site within the aerodrome was not considered significant because of the overall time taken for the unit to reach the site.

The ATSB *Cross Modal Safety Comparisons* discussion paper indicates that general aviation is less safe than travel in transport category aircraft. There are many factors that reduce the level of safety of persons involved in a general aviation aircraft accident. While most relate to the severe forces involved in an aircraft crash, they also include the lack of fire protection afforded by the aircraft structure, and the limited window of opportunity for occupants to either vacate, or be rescued from, a burning aircraft.

The implementation of recommendations from the House of Representatives Standing Committee on Transport and Regional Services report *Regional Aviation and Island Transport Services: Making Ends Meet*, particularly the formation of a working group to advise on the strategic and optimal co-location of fire fighting services, and the provision of fire fighting equipment and crew training to communities where fire fighting services become co-located, should enhance occupant survivability in future aviation accidents. However, due to the design limitations of general aviation aircraft described above, any such service would need to achieve a significant reduction in the current specified response times to ensure any improvement in occupant survivability.

While some enhancement in response times might be possible with the provision of a location specific ARFFS (and commensurate FCC), there remains the problem with the randomness of accident locations as indicated by the data on previous fire related accidents. Since 1992, only 11% of fire related accidents have occurred on, or near major or general aviation aerodromes. The majority of accidents (66%) occurred in areas remote from an aerodrome with just under a quarter of fire related accidents occurring on, or near regional and other aerodromes.

The results of research may eventually improve the burn-through resistance of aircraft structures that will enhance transport category aircraft occupant survivability. However, those improvements will take some time to flow through and provide similar benefits to general aviation aircraft. In the interim, occupants of general aviation aircraft might be able to improve survivability in a post-accident fire by wearing clothing that offers greater protection from heat and flames.

## **CONCLUSION**

The fire fighting arrangements for Bankstown Airport on 11 November 2003 complied with national policy. The response to the accident by the NSW Brigades produced the expected result, in that resources to fight the fire were available within the expected time. Despite the tragic loss of life, the arrangements were deemed to be effective in terms of producing the intended or expected result for which they had been established. The response to the accident was enhanced by the efforts of personnel located on, and adjacent to the aerodrome.

## **SAFETY ACTION**

### Department of Transport and Regional Services safety action

The Department is considering whether an amended difference should be lodged with International Civil Aviation Organization (ICAO) to ensure that any differences between the national regulations for domestic aerodromes and ICAO standards and recommended practices for aerodromes that conduct international operations are apparent.

### Airport Operator and New South Wales Fire Brigades' safety action

Following a post-accident debrief with the Brigades, the Bankstown Airport operator amended the airport emergency plan. In the future, if a safety officer is unavailable at the assembly point when a Brigades' unit arrives, that unit shall proceed unescorted directly to an accident site within the aerodrome.

### Airservices Australia safety action

Airport Services, a business unit of Airservices, has submitted a capital works proposal to replace the Bankstown tower that will include the standardisation of crash alarm and console power switches.