Hell's angels

Aerial firefighters play a vital role in Australia's constant battle against bushfires.

Brad van Wely

THERE IS an element of risk in all aerial operations. But when an aircraft is carrying up to 9,000 litres of water 100ft above a scorching cauldron of fire through a dense smoke haze, the stakes are even higher.

Last summer's bushfires, the worst in a century, sparked heated debate over forest management and emergency response. Hundreds of pilots faced the unique safety challenges posed by aerial firefighting.

There has been no major research on aerial firefighting accidents and incidents in Australia, where the operations have usually proceeded safely.

A Flight Safety Foundation study, the only major research performed on the subject worldwide, showed that diversion of pilots' attention from aircraft control

PHOTO: NICK MOIR/FAIRFAX

Inferno: An Erickson Aircrane carries out firebombing operations in NSW during the January 2003 bushfires.

was a major factor in firefighting accidents involving external load operations in the United States. These accidents accounted for more than half of those considered in the study, an analysis of accident reports filed between 1974 and 1998. Powerplant malfunctions and failures were involved in more than a third of the accidents. And more than a quarter of the accidents occurred when helicopters struck obstacles such as trees and wires during firefighting missions.

The report highlighted the dangers of flying at low altitude in smoke, gusty winds and mountainous terrain.

High density altitude – the lowering of air density due to intense heat – also was a common factor in accidents. High density altitude reduces available engine power at a time when more power is needed to shift heavy external loads.

And as density altitude increases, the efficiency of the rotors decreases, making it harder to keep the helicopter aloft and straight.

Australian aerial firefighters contacted by *Flight Safety Australia* cited fatigue, coordination, communication, situational awareness, hot refuelling and environmental risks as the big issues here.

Firefighting is largely a state responsibility but the safety of aerial operations is governed by Commonwealth civil aviation regulations. Operators can apply for exemptions from the regulations, including those covering flight and duty times.

State government departments enlist private sector operators to reinforce their firefighting ranks.

Although state fire authorities set stringent criteria for contractors, the onus is on aviation companies to ensure their aircraft and pilots are up to the task of working in hazardous and volatile environments.

Many of the country's main aerial work companies draw up their own standard operating procedures and training programs to ensure their pilots do not put themselves or their companies' contracts at risk.

News footage of fixed-wing aircraft and helicopters frantically working to contain

PHOTO: NEWSPIX

Squirrel to the rescue: An AS 350 Squirrel battles the bushfires that raged through Canberra in mid-January.

and suffocate fires paints a picture of chaos to the uninitiated. A closer examination reveals much more order, with each aircraft performing a specific task.

Helicopters used for firefighting such as the Bell 212, Squirrel and Erickson S-64 Aircrane, launch the direct attack.

The smaller, nimble aircraft make more sorties, refilling quickly, while the larger aircraft make fewer trips because they must seek out big water sources further afield.

Helicopters are heavily involved in asset protection because they can hover and target fires more accurately than their fixed wing counterparts.

With their ability to fly and land in confined clearings, helicopters are also used to drop firefighters off in pre-agreed locations, and to tackle fires in mountainous terrain where it is too risky to operate larger aircraft.

Fixed wing aircraft such as Dromader and AT802 are sometimes used to modify fire behaviour by slowing down and controlling backburns. Once the air attack supervisor is sure the backburn has done its job, aircraft join forces with ground crew to extinguish the fires.

While Aircranes like Elvis grab the headlines, the Bell 212 and the Squirrel are the real workhorses in the firefighting effort.

Helicopters use either belly tanks or buckets to carry water. The belly tank makes the aircraft more manoeuvrable, while the buckets cost less – about a tenth of the cost of a tank.

The main disadvantage of the belly tank is the need to find a water source with no obstacles, and to lower the aircraft closer to the water surface.

Both the Bell 212s and Squirrel can be fitted with tanks that can hold thousands of litres of water and which take just minutes to refill.

A hydraulic or electric-powered pump hose with a four-metre extension drives the refilling of the Bell 212s. The pump is dropped just centimetres below the water surface while the helicopter is hovering.

The Bambi bucket can hold from 200 to 9,000 litres of water or foam, depending on the aircraft and the number of crew and amount of fuel on board.

The manufacturers of Bambi have also developed a twin-bucket system designed to be carried by the giant Mil-26 heavy lift helicopter, capable of holding more than 19,000 litres of water.

Bambi buckets are attached to helicopters with lines shackled to the cargo hook on the belly of the aircraft. The lines are long to prevent any loss of control from the rotor wash.

Aerial firefighters must get regulatory approval for the carriage of Bambi buckets, and for low level flying. They

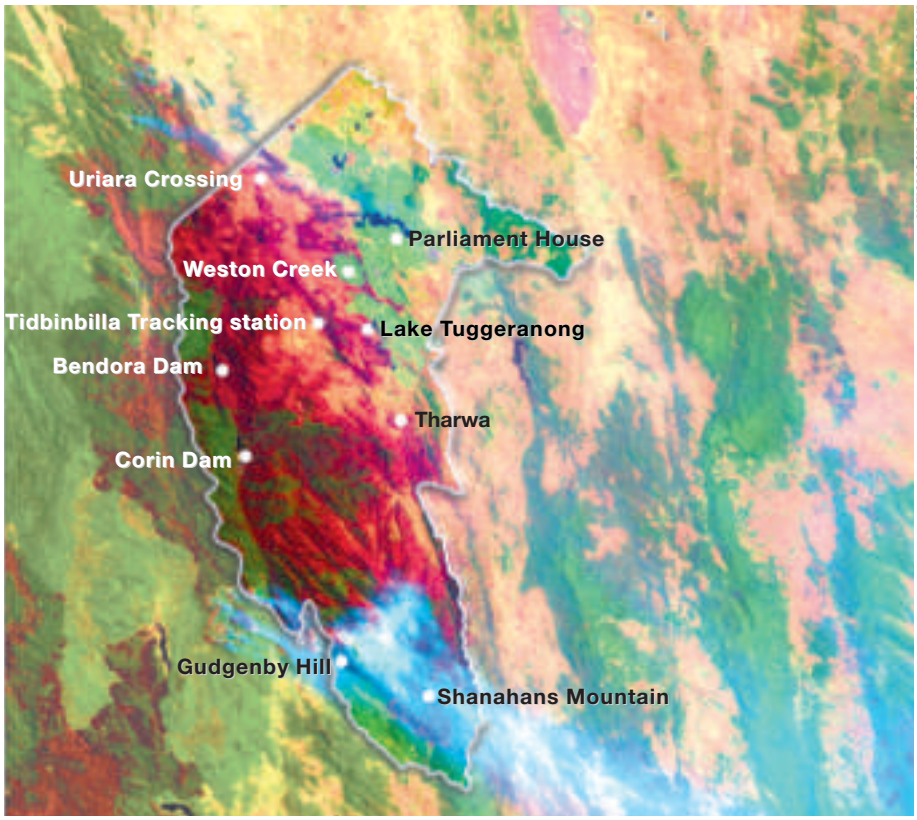

IMAGE: GEOSCIENCE AUSTRALIA

Red centre: A satellite photograph shows the effect the January 2003 inferno had on the ACT.

> **"While Aircranes like Elvis grab the headlines, the Bell 212 and the Squirrel are the real workhorses in the firefighting effort."**

must be well versed in conducting line checks and other long line techniques.

The refilling technique for Bambi buckets varies with the water source available – whether it is slow-moving (stream), fast-moving (river), a large body (ocean) or a portable tank. Pilots fix their eyes on a point on the shore, or on a large object in the water to ensure the aircraft doesn't drift.

Refilling carries some dangers, the main one being the risk of tangling with stumps, logs or other objects. Pilots generally refill from the deepest part of the water source, where possible, to minimise this risk.

Command centre: It is only through the coordinated efforts of those on the ground and in the air that blazes can be contained and extinguished.

Local air attack supervisors are charged with the task of overseeing serious bushfires that require aerial assistance. Trained in all aspects of aerial and ground tactical fire management, air attack supervisors are usually experienced firefighters from state fire authorities.

Pilots involved in aerial firefighting will sometimes be required to fly the air attack supervisor around a fire. This helps the supervisor plan the assault on the blaze.

Daily briefings provide pilots with a better understanding of weather conditions, alternate landing fields and tactical information.

The briefings enable pilots to target their bombing efforts most effectively and work out where firefighters can be positioned on the ground safely.

Before a firebombing air base is established, an air base manager is appointed to organise base and remote fuelling, communication, pilot accommodation, and food and amenities for personnel. The manager enlists aircraft handlers, refuellers, air attack controllers, retardant specialists and air base fire protection crews, and gets water tankers onto site.

Air base managers are usually specially-trained senior firefighters.

FIRE FLYERS

Helicopters used to fight the January fires in NSW and ACT (from top) a Bell 204; a Bell UH-1; an Aerospatiale Gazelle; and a Kaman K-Max.

PHOTO: SIMON BENNETT

Water power: The Erickson Aircrane refills during firebombing operations. Its engines generate 9,600 horsepower, enabling it to lift up to 10,000 litres of water.

Staying in touch: Aerial firefighters need to keep in touch with each other and ground personnel in difficult conditions and, often, on multiple frequencies.

In Victoria, for example, contractors must use at least three different radio systems.

A CTAF (common traffic advisory frequency) is allocated by Communications Australia exclusively for use by relevant fire authorities. Pilots use the fire CTAF to communicate with each other during water bombing to establish a pattern of operation.

With anywhere from one to 100 aircraft in action at any one time in the state, it is essential pilots stay tuned to their CTAF radio to ensure they know the location of aircraft nearby.

During missions involving many aircraft, it is common for a left and right circuit of aerial operation to be established at a fire front, allowing fixed-wing aircraft to water bomb from one direction and helicopters from another.

The 720 VHF radio carried by firefighting aircraft is another critical communications tool, allowing pilots to stay in contact with fire attack supervisors coordinating the water bombing operation.

A "trunking" radio also is mandated in Victoria. Similar to a mobile phone, it allows the pilot and fire supervisor on the ground to talk one-to-one without causing congestion on other frequencies. Operators intending to apply for fire fighting contracts should note the differences in communication requirements between states.

Wire danger: Wire strikes are a constant threat to all low level flying operations. While some maps show known wires, pilots must do their own checks before descending to refill or drop their load of water.

The most common way pilots minimise the risk of a strike is to fly around the ridges in their area of operation before lowering the aircraft.

They need to check continuously for wires and other possible hazards. Visual checks should be made to ensure power lines do not cross ridges in the area, and checks need to be done for power poles, sheds or other electrical infrastructure.

Crew members help by calling out the location of wires they see along the way. They do this even if they think the pilot has seen the wires. Pilots sometimes fly into wires they have seen previously.

THINGS TO COME?

AFTER THE devastation caused by this year's bushfires, there has been renewed talk about Australia's aerial fire fighting capabilities and the possible need for larger, more specialised aircraft.

Aircraft under consideration include the American-built Erickson S-64 aircranes which have featured prominently in the news over the past few summers, the much touted IL-76 turbofan jet cargo aircraft, better known as the Ilyushin, and the Canadair CL-415.

The aircrane helitankers have been a great help in protecting homes and aiding firefighters, given their ability to carry up to 9,500 litres of water and fly longer distances than traditional aircraft.

The $30 million helitanker was a useful resource in the 1998 Macedon fires in Victoria, filling its tanks from lakes, streams and even a golf course pond. Another notable firefighting mission involved two aircranes fighting fires in Brunei and Malaysia in 1998. In one month, the two firefighting helitankers flew 488 hours (about 8.13 hours each day) and dropped more than 45 million litres of water and foam mix on the fires.

The Canadair Bombardier CL-415 amphibious aircraft can fly long distances, drop large amounts of water in concentrated areas and has the ability to fly at night. The Bombardier usually makes between six and 10 drops per hour totalling 36,800 to 61,400 litres, or before refuelling, approximately 20 to 40 drops, 121,000 to 246,000 litres, corresponding to between three and four hours of endurance.

The Bombardier 415 can scoop into a head wind of 90km/h and fly and drop close to the ground when winds of 80 to 100 km/h are blowing. The aircraft is also used in the Mediterranean for search and rescue operations and could be adapted to activities such as coastal surveillance. Each aircraft costs about $27 million.

Also earmarked as a potential addition to Australia's aerial fire fighting capabilities is the Russian-built Ilyushin IL-76. This impressive aircraft is the world's fastest and longest-range air tanker, capable of carrying a remarkable 27,000 litres of water. It can operate day or night and in thick smoke because of the advanced avionics and radar equipment on board. The 153ft long aircraft takes eight specially trained crew to fly.

PHOTO: CANADAIR

Watery landing: The Bombadier 415 amphibian is used in fire bombing operations.

Smother: A Bell 212, one of the firefighting "workhorses" releases a load.

PHOTOS: CHC HELICOPTERS

Ground attack: Fire crew unload their Bell 212.

Fatigue: CHC Helicopter Australia, which has a major firefighting contract with Victoria, has a fleet of up to four aircraft available for duty seven days a week during daylight hours for the duration of the fire season.

Shifts can be long and tiring. CHC has consulted Adelaide University specialists in fatigue and crew management to design a fatigue management system that allows CHC pilots to work a rotating two-week roster system.

The system ensures pilots are in the air for as long as legally possible, while getting enough rest between shifts.

It was based on a computer-rated fatigue score system which took into account other work practice factors such as the concentration level required to perform the dangerous tasks routinely performed by aerial firefighting pilots.

CHC says the result is a good balance for its pilots, considering that on any given day they can make up to 100 water drops during their specified flying windows.

Hot refuelling: To minimise turnaround time, pilots use "hot refuelling" in which they replenish their fuel without shutting down the engine.

The operation can be dangerous, with an increased risk of fire, so pilots generally remain at the controls.

Environmental risk: While saving the environment, firefighters must ensure they do not damage it. One of the key risks is the use of firefighting foam.

The foam is mixed with water to help slow evaporation of the water once it is dropped from an aircraft, by surrounding it with tiny bubbles to minimise the mid-air shearing effect. This increases the amount of water reaching the fire.

At more than a dollar a litre, the foam is used sparingly and only in areas where its use has been approved by local authorities. Pilots may use the foam only when and where instructed.

Environmental damage to areas in which there had been no approval for use of the foam concentrate could open the operator and pilot to litigation.

Elite force: Victoria has strengthened its ability to control remote blazes with the introduction of an elite group of firefighters who form specialised rappel groups. These highly-trained yet little-known firefighters operate in seven-member teams which are airlifted into fire fronts.

Victoria has four rappel teams strategically postioned at three locations around the state – Heyfield (two teams), Myrtleford – Ovens Research Base and Mansfield.

Only a few helicopter pilots are qualified to drop the rappel teams into hazardous areas. The teams carry a huge amount of equipment, including chainsaws, rakes, ropes and water. They are self sufficient for up to 16 hours in remote locations.

In agreement with the air attack supervisor, a trained pilot will hover around 30 ft above a drop zone before holding the aircraft steady to allow the team to drop to the ground down ropes attached

Staging post: A member of the Queanbeyan Rural Bushfire Brigade helps direct operations at Nicholls Oval where a temporary staging area was set up for aircraft involved in water bombing during the January 2003 ACT/NSW bushfires.

to the skids. Heat and smoke, and operating in uncharted terrain make the assignment extremely difficult for even the most experienced pilot.

As with all aerial fire fighting operations, pilots must remain in control of the situation. If they feel they are putting themselves or anyone else in danger, they have an obligation to immediately abort the operation and head for safer airspace. If they have a rappel team aboard, they must find a safer drop zone.

The Australian Transport Safety Bureau has recorded only a handful of aerial firefighting accidents, most of them minor, in the past 10 years.

One highly publicised case was the dramatic rescue of helicopter pilot Duncan Patrick on 13 January at the height of the Canberra bushfire crisis. Patrick's helicopter plunged into Bendora Dam as he replenished the water container amid water bombing activities in forests west of Canberra.

ACT Chief Minister Jon Stanhope was involved in the pilot's rescue. Another rescuer reportedly freed the pilot from the submerged helicopter.

The ATSB investigation into the accident, which underlines the value of training in water egress, continues.

> **"Suddenly, a big fireball and associated smoke plume moved rapidly downhill and engulfed the aircraft."**

Also in January, an Ayres S2R fixed wing aircraft laden with retardant plummeted to a sand dune shortly after take-off from Moruya, on the NSW south coast. The pilot walked away from the crash.

In another incident, a Defence Squirrel helicopter and crew were conducting fire mapping west of Tharwa in the ACT.

The township and outlying properties were under direct threat from the fire. Conditions were hot and turbulent. The front was progressing down steep terrain with strong winds blowing smoke ahead of the fire, reducing visibility.

While probing the firefront, the aircraft enter a creek line at 200ft agl below a major smoke cloud.

Suddenly, a big fireball and associated smoke plume moved rapidly downhill and engulfed the aircraft.

The pilot in command immediately scanned instruments and saw the ASI fluctuating between 0 and 80 knots. The pilot applied maximum power and adopted a climb attitude.

The aircraft was turned to track towards the last known lowest ground.

A crew member maintained a visual lookout for terrain. The aircraft broke clear of the smoke column about 2,200ft AGL, repositioned and completed mapping.