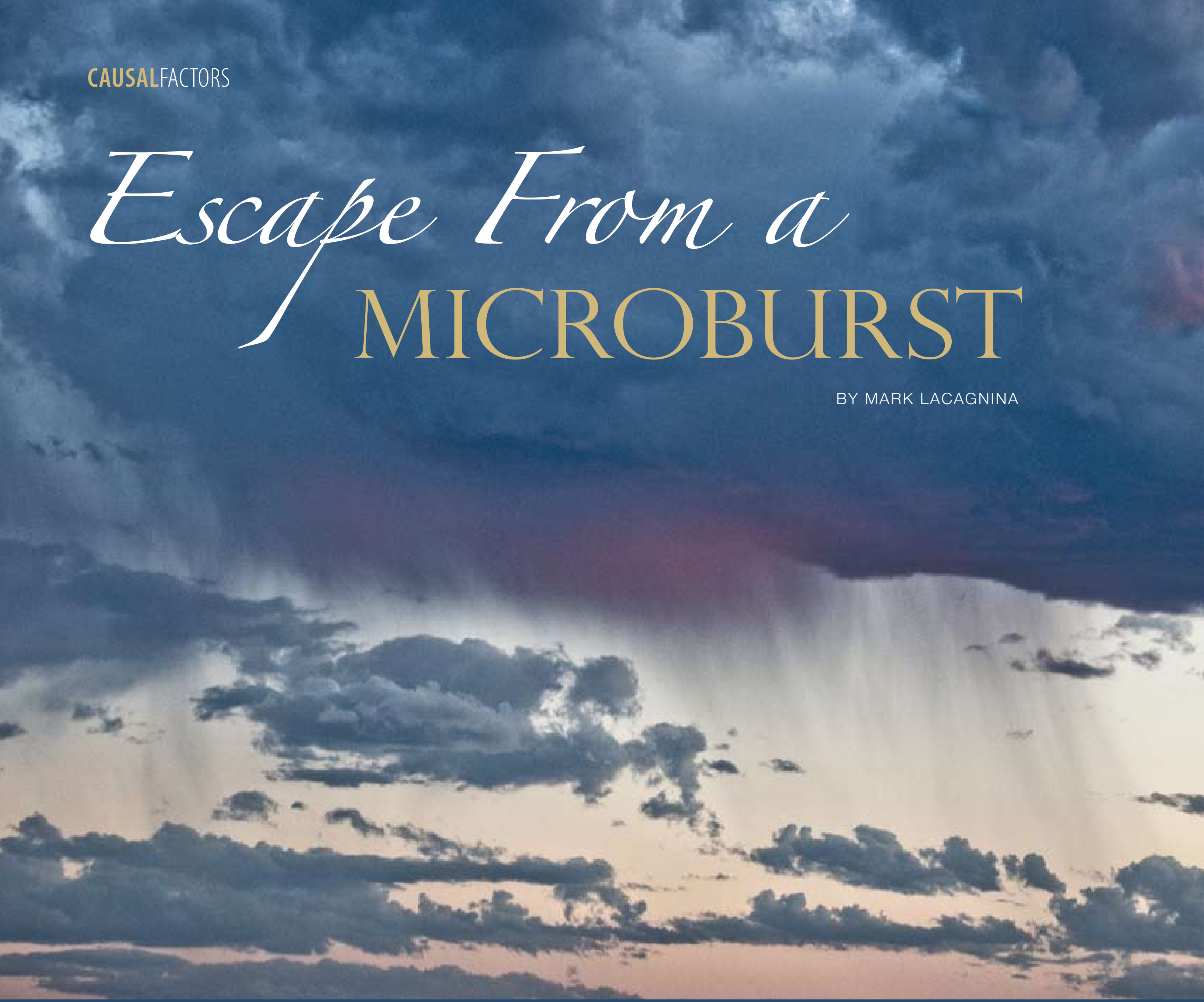

Escape From a MICROBURST

BY MARK LACAGNINA

The PIC conducted a go-around after the 747 was slammed onto the runway.

The flight crew had the sensation of being pushed down and sideways as the copilot began flaring the aircraft for landing at Australia's Sydney Airport. The copilot increased pitch attitude and thrust, but the high sink rate continued until the Boeing 747-400 touched down hard on the runway.

At about the same time, the enhanced ground-proximity warning system (EGPWS) generated a wind shear alert, and the pilot-in-command (PIC) assumed control and initiated a go-around.

The second approach and landing proceeded without further incident. None of the 355 passengers and 19 crewmembers was injured in the April 15, 2007, incident. A few ceiling panels and light fixtures were dislodged during the hard landing, but there was no structural damage to the aircraft.

In a final report published in December 2009, the Australian Transport Safety Bureau (ATSB) concluded that the aircraft had "encountered significant horizontal wind shear associated with a dry microburst that commenced at about 120 ft radio altitude as the flying pilot began to flare the aircraft for landing."

Among other contributing safety factors cited in the report were the absence of a low-level wind shear alert system (LLWAS) at the airport[1] and the inconsistent handling by air traffic controllers of reported information that would have

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improved the 747 flight crew's knowledge about the wind and wind shear conditions they were likely to encounter during the approach.

Implied Risk

The 747 was being operated by Qantas on a scheduled flight from Singapore. The flight crew comprised the PIC, the copilot and two relief pilots.

"The PIC had 18,666 hours total flying experience and had been flying 747-400 aircraft for eight years," the report said. "The copilot had 16,972 hours total flying experience and had been flying 747 aircraft for nine years."

When the aircraft departed from Singapore, there was no indication that weather conditions at the estimated time of arrival in Sydney would cause any problems.

Shortly before the flight crew began their descent from cruise altitude at 1857 local time, they reviewed the latest routine weather report (METAR) for Sydney. Issued at 1830, the METAR indicated that the surface winds were from 030 degrees at 17 kt and that there were thunderstorms 18 nm (33 km) southwest of the airport, moving east-northeast at 15 kt.

"The associated trend-type forecast (TTF) indicated that between 1830 and 2000, there would be 30-minute periods during which thunderstorms, rain and associated low visibility and cloud would be present," the report said.

The Bureau of Meteorology (BOM) told investigators that the TTF did not specifically warn of low-level wind shear because "the risk of wind shear, which is a potential hazard associated with all thunderstorms, is implied when a forecast or warning of thunderstorms is issued," the report said.

During descent, the crew used their weather radar system to gauge the vertical extent of the thunderstorms. "The only significant buildup was … greater than 15 km [8 nm] south of the airport," the report said. "The radar showed no significant cells in the terminal area."

Air traffic controllers were inconsistent in providing current wind shear information to the fight crew.

Out of the Loop

Landings and takeoffs at Sydney Airport were being handled by two aerodrome traffic controllers (ADCs). "ADC West" was responsible for traffic using Runway 16R-34L. "ADC East" was responsible for Runway 16L-34R. Runway 34L and Runway 34R were in use.

As the 747 neared Sydney, the ADCs received several wind shear reports. The crew of a 737 reported overshoot wind shear[2] between 1,500 and 700 ft above ground level (AGL) on approach to Runway 34L. Another report of overshoot wind shear was made by a pilot who landed on Runway 34R. After hearing this report, another pilot on approach to that runway initiated a go-around.

Because they were on a different radio frequency, the 747 crew did not hear the reports when they were made or when they were relayed by the ADCs to the crews of other aircraft on approach or preparing for departure. One crew decided not to take off and taxied off the runway.

Significantly, the ADCs did not forward the wind shear reports to the Sydney Airport Meteorological Unit (SAMU). "Had the SAMU received details of the pilot reports of wind shear, it is likely that a SPECI [special report], highlighting the likelihood of wind shear, would have been issued prior to the arrival of VH-OJR [the 747]," the report said. "The availability of that information would have allowed the flight crew to better prepare for the likely conditions affecting their approach."

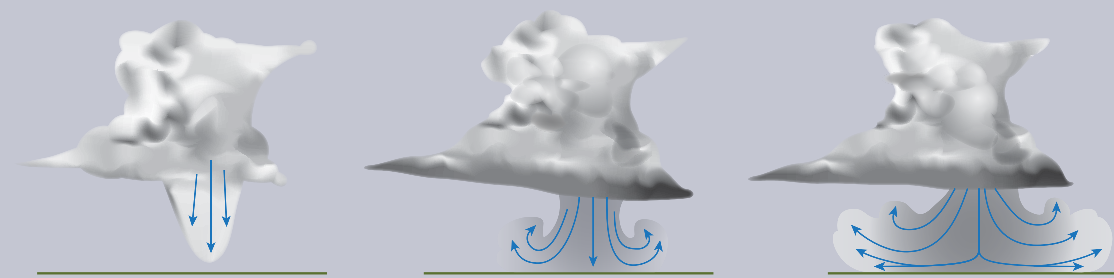
However, at 1908, the automatic terminal information system (ATIS) was revised to include the 737 crew's report of overshoot wind shear and to change the altimeter setting. The aerodrome traffic director broadcast the new information on the local frequencies.

The 747 crew was on an approach control frequency and did not receive the new ATIS information with the wind shear report. When they asked the approach controller for an update on weather conditions in the terminal area, they were told to stand by.

Rapid Wind Changes

The 747 crew did not hear the ADC West controller advise a departing crew that the indicated surface wind direction and velocity at the threshold of Runway 34R had changed from northerly and light to southerly and 20 kt.

Development Stages of Microbursts



Source: Wikipedia

Figure 1

They also did not hear another crew on approach to Runway 34R report that they were going around, or the ADCs' subsequent change of arrivals and departures to Runway 16L and Runway 16R.

At 1910, "the approach controller made a general broadcast that there were cumulonimbus clouds (thunderstorms) in the area," the report said. The controller then told the 747 crew that they could expect to land on Runway 16R.

At 1913, the ATIS information again was revised. The new broadcast, Romeo, stated in part that surface winds were from 190 degrees at 10 to 20 kt, visibility was greater than 10 km (6 mi) with showers in the area and scattered clouds at 4,000 ft.

The report said that ATIS Romeo should have included a wind shear warning. "That information was very relevant to the pilots of VH-OJR in endeavoring to conduct a safe approach and landing."

The approach controller provided the 747 crew with details of ATIS Romeo before handing them off to the traffic director.

At 1917, the traffic director told the crew to advise him when they had the airport in sight. The 747 was the first aircraft sequenced for landing on Runway 16R following the runway change.

'Expect Wind Shear'

ATIS Sierra was issued at 1918. Among the changes were notification of cumulonimbus clouds in the area and the statement: "Significant weather — expect wind shear below 3,000 ft."

The traffic director told the 747 crew to intercept the localizer for Runway 16R. The traffic director then relayed the significant weather advisory to all aircraft on his frequency.

At 1920, "the crew of the first aircraft to land on Runway 16L after the runway change reported to ADC East that they experienced 'quite a bit of shear on final approach,'" the report said. When ADC East asked for details about the encounter, the crew said that they had experienced overshoot wind shear followed by undershoot wind shear at 100 ft.

ADC East did not relay the details about the wind shear encounter to ADC West or to the SAMU.

The 747 was descending through 1,900 ft when the crew advised the traffic director that they had the airport in sight. They were cleared for a visual approach to Runway 16R and told to establish radio communication with ADC West.

The aircraft was about 3 nm (6 km) from the runway at 1922, when the crew told ADC West that they were on final approach to Runway 16R. "ADC West advised the crew that the wind at the landing threshold was 180 degrees at 22 kt, issued a clearance to land and requested a wind readout," the report said. "The crew reported that the wind at 1,000 ft was a 20-kt tail wind."

The copilot disengaged the autopilot and autothrottles at 780 ft AGL and asked the PIC for continuous callouts of wind data. The PIC's callouts indicated that the wind changed from the tail wind to a 15-kt head wind at 500 ft AGL and to an increasing right crosswind at 120 ft AGL.

'Storm Cell Outflow'

"Investigation revealed that the aircraft was influenced by outflow descending from a high-based storm cell that developed into a microburst," the report said.

According to the BOM, the base of the line of thunderstorms was about 12,000 ft. Moving from the southwest at 22 kt, the leading edge of the line reached the airport at 1920. The microburst that developed over the threshold of Runway 16R was most intense when the 747 was 3 nm from the runway, and it moved west as the aircraft neared the runway.

The approach had been stable until the 747 encountered overshoot wind shear followed by undershoot wind shear. Recorded flight data indicated that calibrated airspeed increased from about 146 kt to 159 kt at 120 ft AGL and then decreased at a steady rate during the next six seconds to 131 kt on touchdown. Reference landing speed was 144 kt.

The report said that the crew could not have prevented the hard landing. The recorded sink rate was 820 fpm, and vertical acceleration was 2.34 g when the main landing gear contacted the runway at 1923. The aircraft then apparently bounced.

The PIC's decision to go around was appropriate and in accordance with company procedure and training, the report said. "Recorded flight data showed a rapid forward movement of the engine thrust levers within two seconds of the initial touchdown. The PIC said that he did not select the TOGA [takeoff/go-around] switches but adopted the quicker method of manually advancing the thrust levers to achieve go-around thrust."

The aircraft touched down again with a vertical acceleration of 1.53 g before climbing away within seven seconds of the initial touchdown.

After the incident, Qantas maintenance technicians reattached five cabin ceiling panels and two emergency lights that had dislodged, and conducted a structural inspection of the aircraft. "That inspection did not reveal any abnormalities," the report said.

Warning Systems

The EGPWS was the only system aboard the 747 that could provide wind shear warnings. "However, because the system was reactive, and because the wind shear developed so quickly and occurred when the aircraft was at a very low altitude, the aircraft contacted the runway before the warning was triggered," the report said.

The weather radar systems in 12 of the 33 747s in the Qantas fleet had been equipped to provide predictive wind shear warnings. The equipment had not been fitted to VH-OJR.

However, the report said that the equipment likely would not have detected the wind shear created by the dry microburst because it depends on measurements of changes in the velocity of moisture and particles in the air ahead of the aircraft.

Another warning system, air traffic control, did not provide sufficient and timely information to the crew, the report said. "The differences in the quantity and quality of wind and wind shear information that was provided to the flight crew by the aerodrome controllers revealed the limitations of human information processing and decision making in a rapidly changing situation."

This Boeing 747 experienced the microburst event.

The findings of the investigation prompted the BOM to launch a study of the need for an LLWAS at Sydney Airport. The report said that the study was to be completed in April.

This article is based on ATSB Transport Safety Report AO-2007-001: "Microburst Event; Sydney Airport, NSW; 15 April 2007; VH-OJR, Boeing Company 747-438."

Notes

1. At the time, no airports in Australia had an LLWAS.
2. Overshoot wind shear occurs when an aircraft encounters an increasing head wind, a decreasing tail wind or an updraft that causes an increase in indicated airspeed and/or a deviation above the desired flight path. The opposite holds for undershoot wind shear.