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A Very Halting Affair to Remember

A320 Braking Failures Implicate Control Unit

Braking problems with the **Airbus** A319/A320 and A321 family are officially on the radar screen. Five incidents in three years in the United Kingdom involving a loss of braking after touchdown are bringing safety concerns to the forefront. The UK **Aircraft Accident Investigation Board** (AAIB) has requested Airbus provide an automated warning to crews on the loss of braking effectiveness after touchdown or rejected takeoff.

The hazards involved are very real — as evidenced by the overrun accident of **Leisure International Airways** A320 (registration G-UKLL) at Ibiza Airport (IBZ) in Spain on May 21, 1998, and the near overrun of a **Skyservice Airlines** A320 (reg. C-FTDF) at Cardiff Airport in the UK on Aug. 3, 2003.

The AAIB just released the details of the Canadian registered Airbus A320 of Skyservice Airlines. On finals to Runway 30, the Electronic Centralized Aircraft Monitoring (ECAM) display showed a STEERING caption. The pilot cycled the Anti-SKID & N/Wheel STRNG switch in an attempt to reset the Brake and Steering Control Unit (BSCU). It appeared to have successfully reset but after touchdown the aircraft did not decelerate normally under auto-braking.

The pilot depressed the brake pedals fully but no deceleration was felt. He then selected maximum reverse thrust and the copilot cycled the A/SKID & N/W STRNG switch. The pilot again attempted toe-braking but without any effect, so the crew selected the A/SKID & N/W STRNG switch to OFF. The commander was then able to brake effectively to bring the aircraft to a halt about 130 feet (40 meters) from the end of the runway, bursting three main-wheel tires and damaging a landing-gear light. There had been no warning at all on the ECAM and so the captain, due to his gentle braking inputs, had taken between 10 and 13 seconds to realize that the BSCU had in fact failed.

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Dicing With Icing: Smaller Aircraft Still Susceptible

With the number of icing-related accidents thus far this season, the **Federal Aviation Administration**'s (FAA) planned safety meeting on Feb. 18 in Washington, D.C., to analyze the safety of corporate jets and on-demand charters must have been distracted somewhat by events nearly 1,700 miles away. Two days before the meeting, one of two **Citation V**s traveling in consort (Reg. N500AT), had crashed in icing conditions during an approach at Pueblo, Colo., killing all eight onboard. The conditions were described as low cloud, freezing fog and drizzle.

A witness heard three distinct popping sounds just as the airplane went down at around 0913L. Initial speculation was that the airplane had flown through freezing drizzle and that the de-icing system may have been overwhelmed. In fact, typical of its class, this aircraft is not cleared for flight in severe icing. There have been a number of precedents *(see table, "Citation Crashes" on p. 4)*.

It causes one to wonder just what precise icing mechanism is involved here. The Citation was the subject of at least two FAA directives on ice that required operators to modify planes or procedures. A March 1998 directive required a new warning to be included in the flight manual cautioning that freezing drizzle and other conditions could lead to an ice buildup that "may seriously degrade the performance and controllability of the airplane." An April 2000 directive required revisions to the flight manual and to a computer that calculates minimum safe airspeed.

(See Icing on p. 4)

(Cont'd from p. 1)

The Incident

For noise abatement, the captain had decided to use idle reverse only and LOW on the Autobrake, the runway being adequately long. The approach was uneventful until, passing 1,000 feet, the aircraft's status page changed from Cat III DUAL to CAT III Single. This downgrade meant that any single system failure would terminate the automatic approach. Simultaneously, an amber STEERING caption was noted on the ECAM's WHEEL page. A cycling of the A/SKID & N/W STRNG extinguished the caption and a restored status of Cat III DUAL then showed. Neither pilot could recall *re-selecting* autobrake after cycling the switch. After touchdown and idle reverse selection, the copilot noted that the autobrake was not functioning and called out "Manual Braking." The pilot selected full toe-braking, but gingerly and over a period of 10 seconds. Eventually recognizing "no joy on the braking front," he applied full reversing and instructed the copilot to cycle the A/SKID & N/W STRNG switch. This had nil effect, so he ordered the switch turned OFF in order to access stored hydraulic pressure in the accumulator. Braking was now available, and he urgently brought the aircraft to a halt. With three tires burst and a fourth damaged, the runway was blocked until the tires were changed.

The cockpit of an Airbus A320, similar to that of the Skyservice Airlines jet that did not decelerate normally under auto-braking at Cardiff Airport in the United Kingdom on Aug. 3, 2003.

Source: Fsim2000.net

The Systems

The A/SKID & N/W STRNG switch removes anti-skid protection requiring the pilot to refer to the triple pressure gauge in order to keep toe-braking pressures below 1,000 psi and not blow tires. The A320 brakes operate off normal GREEN system with the Alternate YELLOW system using stored pressure. The BSCU is a two-channel computer that controls anti-skid and autobrake functions (the latter being MAX/Med or Low). In addition to Normal braking (autobrake with anti-skid) there are three other modes:

a. Park Brake (ON or modulated cautiously) — the last-ditch non-differential unsteered option;

b. Alternate braking with anti-skid (toe-pedal operation with anti-skid); and

c. Alternate braking without anti-skid (pedal-braking due to BSCU failure or A/SKID & N/W STRNG selected to OFF).

Manufacturer Airbus could not replicate the fault codes recorded by the BSCU BITE (built-in test), the CFDS (Central Fault and Display) nor the flight data recorder (FDR). However, very brief "micro-cut" power interruptions revealed a problem in the separate power supplies for the two BSCU channels. The FDR disclosed that the cycling of the A/SKID & N/W STRNG on finals had caused a swap-over in the active BSCU channels and a consequent silent loss of autobrake arming. In a word, "tricky." After touchdown, the spoilers had extended and reverse operated, but due to lack of auto-braking the ineffectiveness of these two devices at lower speeds quickly caused the rate of deceleration to drop off from its peak of 0.18g. Nineteen seconds after touchdown, the pilot's selection of max reverse brought the deceleration back up to 0.19g only. Effective longitudinal deceleration, peaking at 0.4g, only became apparent

(See Airbus Brakes on p. 6)

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A BA 747 Crosses The Safety Rubicon — Or Did It?

On Feb. 20, a **British Airways** [BAB] 747 (Flight 268 en route from Los Angeles to Heathrow) diverted itself to Manchester after declaring a Mayday for being short on fuel. Bearing in mind that Manchester isn't that far short of Heathrow after a continental USA and Transatlantic crossing and that the UK weather wasn't bad, what could have caused this last minute diversion? It would appear that the aircraft was advised by LAX air traffic control (ATC) just after departure that it was trailing 20 feet of flame from its #2 engine. Probably a surge, so it was given the rest of the day off. But the BA crew, with three good engines, decided to plow onward across the Atlantic. This is not uncommon for British Airways.

It had been done by another BA crew out of LAX last November in similar circumstances — thereby creating, or rather maintaining, a reliable precedent. Indeed, many other airlines would also rather keep heading for a "home-base" than dumping tons of fuel, creating scheduling havoc and necessitating a later non-revenue three-engine ferry back to a maintenance base. Think of the loss of utilization involved; the aircraft could be out of service for up to a week.

But there may have been another reason. The incident happened three days after a European regulation came into force requiring airlines to compensate passengers for long delays or cancellations. Under the new rules, if the pilot had returned to Los Angeles, BA would have been facing a passenger compensation payout of more than £100,000 (US$191,465), on top of a whole swag of other costs. The EU regulation, which carriers consider punitive, requires airlines to refund passengers the full cost of their tickets as well as flying them home if a delay lasts longer than five hours.

The greatest risk in a three-engine ferry flight is the three-engine takeoff, even though it is regularly done for reasons of economics. So heading off on a nine-hour Translant on three donks in a 747 is not really breaking new ground. However, not having declared any sort of emergency, the crew was left a little flat-footed when Oceanic then lumbered them with a non-optimal flight level and fuel started looking a bit tight in the headwinds at the assigned level.

As he approached Blighty, the pilot deemed it advisable to declare a PAN or Mayday as he further discovered that some of the fuel on board was inaccessible. This advisory signified to ATC that he had a minor problem and would appreciate their earnest cooperation. At some later stage he then wisely, as it turned out, opted for the nearer airfield. Passing 4,000 feet in the descent, the pucker factor increased and he upped his alert phase to a Mayday once resident on a more discreet VHF frequency of 121.350MHZ. He asked for a sterile runway and stated that he had insufficient fuel even for a go-round at Manchester. 200 kg/min is the consumption figure in the landing configuration and they'd only have 2,000 kg to spend on arrival — so all resoundingly good decisions. His bid for attention thus duly noted, the ATC slot auctioneer declared the Manchester priority slot sold to the gent with the high-pitched voice — and the rest of the flight was uneventful.

But it does demonstrate how an accident chain can build, with one of the classic links being the "best of intentions" and another being the standard set by the airline. After all, ETOPS (extended range operations) doesn't yet rule in the four-engine world. So it's not even bending the rules if you opt to press on rewardless, with or without company consensus. Many pilots have been caught out by similar decisions becoming derailed. But even though they might overspeed their circular slide-rules en route, and overstress their worry beads, as long as all the factors are known and factored in, what could possibly go wrong? Suddenly finding out that fuel below a certain level won't transfer could have been a sudden reintroduction to the real world of "Numpty."

'Numpty' Defined

"Someone who (sometimes unwittingly) by speech or action demonstrates a lack of knowledge or misconception of a particular subject or situation to the amusement or bafflement of others." (Scottish usage)

Numpty's Rule states that if there's something vital that you don't know, you are eventually destined to find out at the worst possible moment. But then again, not knowing the details of the dead #2's fuel tank inaccessibility via the override/jettison pumps at fuel levels lower than three tons, it may have been Murphy's Law in play here (if anything can go wrong it will, at the worst possible time). If so, then it may turn out to be a simple case of disregarded terminal conjunctivitis. That is the condition wherein a pilot stares at his conjunctiva (the inside membrane of the eyelid), concludes that he cannot see the light at the end of the tunnel, and resolves not to traverse said tunnel. You never press on with your eyes shut to the possibilities. There's much to be said for not entering the Kingdom of Unseen Peril. In that realm even the aircraft cleaner is allowed to question your flawless decision-making, using his 20:20 hindsight. But it's OK if your plan is endorsed and that's the beauty of modern comms. But were the 351 passengers impressed? What were they told? Putting on our Flight Simulator 2000 BA PR hats here, we will hazard a guess. Come in spinner. "Landing with 2T useable (and 3T suddenly unusable) after crossing the continental USA and the Atlantic is a fine feat of airmanship. No one could cut it any finer." ✈

Icing *(Cont'd from p. 1)*

According to a **National Transportation Safety Board** (NTSB) report on the Dec. 30, 1995, crash of a C560 in Eagle River, Wis., that jet was circling to land when it hit the ground about a quarter-mile from the runway threshold. The two pilots were killed; there were no passengers aboard. "The left wing and horizontal stabilizer leading edges had approximately one-eighth inch of rime ice adhering to their leading edges," the NTSB report said. Police reported precipitation in the form of freezing rain and sleet at the time of the accident, the safety agency added.

The NTSB said investigators found "both engines contained a small area of ice approximately 5 inches in diameter, which had formed beneath the final turbine wheel." The safety board attributed the probable cause of the accident to the failure of the pilot to maintain airspeed while executing the circling approach, along with factors that included "the descent below minimum descent altitude, the fog, the low ceiling and the icing conditions."

Citation Crashes on Approach in Icing

Date	Reg.	Circumstances (all icing conditions)
Feb. 16, '05	N500AT	On circling approach Pueblo, Colo.
Jan. 1, '05	N35403	Landed 450 ft. short at Ainsworth, Neb., heavily iced
Mar. 26, '00	N130MR	Crashed in finals turn in fog, drizzle, Buda, Texas
Unknown	Swiss	C560 crash on finals Augsburg, Germany
Feb. 19, '96	D-CASH	Crashed turning finals Freilassing, Germany
Dec. 30, '95	N991PC	Crashed during circling approach Eagle River, Wis.
Jan. 25, '95	D-CHVB	Crashed on attempted go-round Allendorf, Germany
Nov. 19, '79	N555AJ	Crashed on approach in icing conditions, Castle Rock, Colo.

Source: NTSB

Giving Icing the Boot

On the Citation's wing and tail leading edges, cyclically inflatable deicer boots allow ice to build up and then shatter it. However, in common with many turboprops, the light bizjets cannot cope with super-cooled large droplets of freezing precipitation that accumulate all over the airframe. That type of icing just hits and sticks and builds up. The Citation's pneumatic boots cycle courtesy of 23 psi service bleed air. Besides OFF, it has 2 positions. AUTO does the tail then the wings via an auto-timer and MANUAL chucks hot bleed air to all four boots simultaneously (i.e., untimed). The inner wing panels in front of the engines are bleed air anti-iced, therefore, in theory, any "shed" ice won't be ingested by the engines if it's switched on in time (before the ice accumulates).

But there's the rub. Imagine that the system is in AUTO during the descent and initial approach. According to the NTSB and FAA's cautions, the system won't cope in severe rain-ice, so a layer will build up. When the pilots come visual below clouds and start their circling approach, they note the ice accumulation and switch to MANUAL to get rid of it. But at the same time they are "dirty" with gear and 15˚ flaps and starting their level turn

A firefighter douses the C550 that crashed at Freilassing, Germany, on Feb. 19, 1996.

Source: German Federal Bureau of Aircraft Accidents Investigation (BFU)

onto finals (for which they'll drop 35˚ flap).

That's a lot of drag in a level turn, so they'd be simultaneously boosting the RPMs considerably because they know that the iced-up stalling speed in the base-turn is that much higher. The combination of changed angle-of-attack (due to flap and ice), higher IAS (indicated airspeed) and one other factor might have been enough to dislodge some ice from the inner wings. Why? Because those inner wing panels are bleed-air heated and suddenly at the higher RPM's the engines are belting out a higher volume of hotter air, possibly in continuous flow MANUAL (and the ambient temperatures are greater near the ground anyway).

Courtesy of the much reduced air-pressure over the inner wing panels in the flapped turn onto finals and the suddenly hotter air-heated panels beneath the thick layer of ice, the ice-sheet shatters and is sucked into the engines (which at the higher RPMs are sucking that much harder anyway). If N500AT was in a circling approach near Pueblo, Colo., that would explain the popping that was heard just before the aircraft suddenly dropped out of the sky at a rate, from the NTSB's initial findings (based on secondary radar height reports) of about 2,600 ft./min. over its final 30 seconds.

Here's another theory. Even without iced wings and tail, you can easily hit the pre-stall buffet due to urgently racking on the finals turn bank angle with a following (tightening) wind component — in order to roll out on center-line. Any such stall buffet encounter would cause a pilot to instinctively go for high/max power and the shaking, wing-flexing and turbulent airflow over the wing would've helped liberate the inner wings' upper surface ice-sheets.

Whichever it was at Pueblo, as the data shows, N500AT suddenly picked up an alarming descent rate that put it into the ground quicker than a lightning strike. A stall in a turn due to the higher stall speed with ice-covered wings and tail, or ice ingestion and loss of thrust? Either or both would've done it.

In AD 98-04-38, the FAA action proposed revising the Limitations Section of the FAA-approved Aircraft Flight Manual (AFM) to specify procedures that would:

✔ Require flight crews to immediately request priority handling from Air Traffic Control to exit severe icing conditions (as determined by certain visual cues);

✔ Prohibit flight in severe icing conditions (as determined by certain visual cues);

✔ Prohibit use of the autopilot when ice is formed aft of the protected surfaces of the wing, or when an unusual lateral trim condition exists; and

✔ Require that all icing wing inspection lights be operative prior to flight into known or forecast icing conditions at night.

That action also proposed revising the Normal Procedures Section of the FAA-approved AFM to specify procedures that would:

✔ Limit the use of the flaps and prohibit the use of the autopilot when ice is observed forming aft of the protected surfaces of the wing, or if unusual lateral trim requirements or autopilot trim warnings are encountered; and

✔ Provide the flight crew with recognition cues for, and procedures for exiting from, severe icing conditions.

Impractical Rule-Making

As with many such prohibitive and prophylactically impractical regulations, the overall endgame effect is to indemnify the regulator's DNA but leave the pilot pregnant with risk and eventually holding the baby. On the one hand, it's readily admitted that unforecast and rapid onset of severe icing can be encountered without warning, yet the Mandrake solution is supposedly to avoid it, recognize it with your Xray vision — and stealthily escape it. That's like optimistically walking in an open field under a cloudy sky with water-soluble hair-dye while wearing rose-tinted sunglasses. The fact that one of the two C560s had no problems five minutes later adequately points to how quickly icing conditions of moisture, temperature and air-mass can change. The FAA's solutions in the box at right are, at best, quixotic abstractions:

Legislating against accidents is like shouting against the wind. In standard winter weather, if pilots were to strictly observe these cautionary platitudes, there'd be aircraft strewn all over the ATC landscape urgently seeking to escape the clutches of old Jack Frost. There'd be more credibility in just acknowledging severe icing as being a potentially lethal operational hazard — just like flocking birdstrikes. Such banal bromides in Flight Manual Warnings are really a tacit admission that the FAA's certification requirements fall well short of the aircraft's operational flight envelope. What's needed is one of those famed FAA "raisings of the bar" for icing protection.

In this publication *(ASW Nov. 10, 2003, p. 7)*, we described a system based upon laser mensuration monitoring and thermal laser de-icing on the ground (and de/anti-icing airborne) that could be tomorrow's solution to these everyday killers. It was originally proposed as a solution to the identical problem in turboprops where prop rotation direction can additionally lead to a spanwise asymmetric distribution of ice accumulations and a consequent deadly stall-spin outcome. However, it is equally applicable to smaller and larger jets. ✈

Procedures for Exiting A Severe Icing Environment

These procedures are applicable to all flight phases from takeoff to landing. Monitor the ambient air temperature. While severe icing may form at temperatures as cold as -18 degrees Celsius, increased vigilance is warranted at temperatures around freezing with visible moisture present. If the visual cues specified in the Limitations Section of the AFM for identifying severe icing conditions are observed, accomplish the following:

● Immediately request priority handling from Air Traffic Control to facilitate a route or an altitude change to exit the severe icing conditions in order to avoid extended exposure to flight conditions more severe than those for which the airplane has been certificated.

● Avoid abrupt and excessive maneuvering that may exacerbate control difficulties.

● Do not engage the autopilot.

● If the autopilot is engaged, hold the control wheel firmly and disengage the autopilot.

● If an unusual roll response or uncommanded roll control movement is observed, reduce the angle-of-attack.

● Do not extend flaps when holding in icing conditions. Operation with flaps extended can result in a reduced wing angle-of-attack, with the possibility of ice forming on the upper surface further aft on the wing than normal, possibly aft of the protected area.

● If the flaps are extended, do not retract them until the airframe is clear of ice.

● Report these weather conditions to Air Traffic Control. ■

Source: FAA

Airbus Brakes *(Cont'd from p. 2)*

28 seconds after touchdown — but three sharp spikes on the FDR noted the rapidly resultant tire-bursts. The aircraft came to rest 50 seconds after touchdown. Data loss from the BSCU was noted 23 seconds after touchdown (equating to the copilot's cycling of the switch).

Confusing Signals

The copilot's call for "Manual Braking" had confused the pilot. The lack of any ECAM warning had the captain in a mindset that the discrepancy would be associated with the selector switch rather than with the braking system. The fact that he had then taken 10 seconds to apply full toe-brake deflection was related to the captain's apprehension about the sensitivity of the A320 brakes, his reluctance to cause passenger discomfort and his notion that it was just a switch discrepancy. Obviously, his lack of A320 manual braking experience would also have been a factor. Only latterly, due to the scheduled low deceleration of standard arrivals, did he realize that there was in fact nil braking under way. His initial decision to then call for the switch to be cycled (rather than switched OFF per the recall drill) was because he was reluctant to lose nose-wheel steering. Toe-brake pressures must also be released during this cycling and switching.

The AAIB has resolved that the BSCU was at fault, however, it has not been possible to explain its behavior (but read further on this below in the **Leisure International Airways** Flight 4064 accident commentary). The crew "missed" the fact that cycling the A/SKID & N/W STRNG switch on finals would kill their autobrake (as the BSCU switched active channels). Because the autobrake was then disarmed, no autobrake failure chime could occur to alert them. *"Tricky."* The cycling of the A/SKID & N/W STRNG on the roll-out was against the Flight Crew Operating Manual (FCOM) recommendation and that exercise chewed up a lot of runway available.

Delays in achieving effective wheel-braking were related to decision-making and use of idle reverse. It is worth noting that the standardised use of idle reverse for noise abatement by a **Qantas** 747 crew in Bangkok on Sept. 23, 1999, was a factor in that overrun also *(ASW, May 7, 2001)*. Eventual use of harsh braking "as required to stop within runway available" resulted in this pilot almost inevitably blowing the three tires. Earlier moderate use would have resulted from A/SKID & N/W STRNG OFF, useful reverse and a non-timid initial use of foot-brakes. Flight crew manuals should advise crews to apply maximum reverse anytime the rate of deceleration is suspect … before any troubleshooting.

The BSCU

A major factor in the captain's uncertainty was the lack of any warning of the BSCU problem because the Flight Warning Computer (FWC) does not actively monitor the BSCU. This computer (the BSCU) has previously figured in a number of similar deceleratory sagas. In the G-UKLL accident, the A320-212 ran un-braked off the runway end at Ibiza, although the crew could have used the park-brake — but their training had never included any mention of it being utilized as an emergency brake. The operating manual states that operating the parking brake deactivates the other braking systems. That might constitute a psychological deterrent. G-UKLL's initial problem had occurred when the handling pilot selected Autobrake Low; a failure triggering in both BSCU channels but the

The Brake and Steering Control Unit (BSCU) of **Leisure International Airways** Flight 4064 (Reg. G-UKLL).
Source: Spanish Accident Board

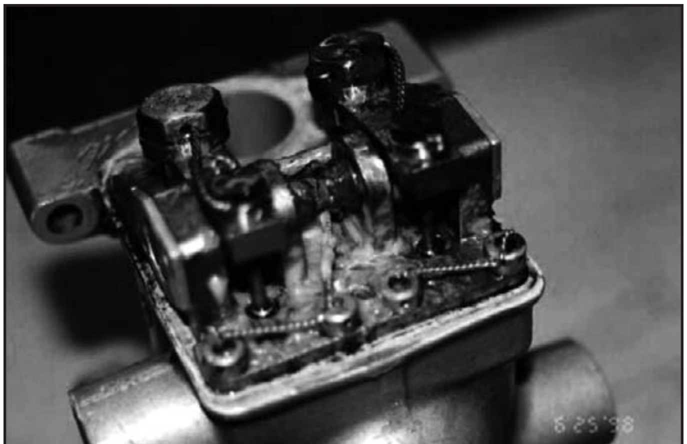
pilots were unaware that Normal braking would be disabled. The Abnormal and Emerg Procedures section of the manual had no BSCU reset procedure but there was one in FCOM-Supplementary Techniques; however they were unaware of its applicability in this scenario. In any event Alternate System braking should have been available.

However, a latent and dormant fault within the Brake Dual Distribution Valve (BDDV) had disabled the Alternate System also. That failure was caused by a slushy frozen mixture of water and detergent restricting movement in the rocker arm in the lower part of the BDDV. Although a composite of failures, the inability to stop was kicked off by the BSCU's twin channels' simultaneous fault modes (per the later 2003 Skyservice Airlines C-FTDF event at Cardiff).

Peter Ladkin, professor of computer networks and distributed systems at Germany's **University of Bielefeld**, explains the BSCU's internal "interfere-ometry" as follows:

The BSCU has two identical channels, active ("hot") and standby, and there is a command (COM) and monitor (MON) function of the BSCU. MON checks COM for agreement before output is sent. Upon detection of a disagreement, a "disagree" condition is logged in the BSCU as well as sent to the Centralized Fault Data Interface Unit (CFDIU).

If a fault develops, it is detected in the hot channel. If hot and standby channels are both functioning, the system then transfers control to standby, which becomes hot and operates non-redundantly (that is, the faulty channel remains permanently cold). If standby is cold, hot remains



The Brake Dual Distribution Valve (BDDV) from the Leisure International Airways A320-212 that ran un-braked off the runway at Ibiza Airport in Spain on May 21, 1998. A latent and dormant fault within the BDDV had disabled the brakes' Alternate System as well. That failure was caused by a slushy frozen mixture of water and detergent restricting movement in the rocker arm in the lower part of the BDDV.
Source: Spanish Accident Board

active, control is not transferred, and one must then live with whatever functions are still provided by the faulty hot channel … not exactly triple redundancy.

The BSCU performs a functional test on selection of Landing Gear Down, opening the Normal Selector Valve, which allows pressure from the Green hydraulic system to reach the four servo valves of the Normal system (Normal Servo Valves, NSVs). The BSCU then sends current momentarily to the NSVs and monitors the pressure rise. It then closes the NSVs, closes Normal Selector Valve, and then opens the NSVs again to release the pressure. This will have happened on the incident flight, the accident report says.

If the Normal braking system is inoperative, Alternate braking is made available by a spring-biased changeover valve (Automatic Selector Valve) which allows pressure from the Yellow hydraulic system to the Alternate braking system. Alternate braking is achieved through foot pedal pressure, transmitted hydraulically along a low-pressure line and ported through a Brake Dual Distribution Valve (BDDV) and a Dual Shuttle Valve to the Alternate servos on the brakes (these being separate devices from the NSVs). Antiskid is controlled by the BSCU, if still operative and selected.

One problem is as follows. The status of the BSCU switch is sampled every 20 msec asynchronously by the COM and MON functions. It is possible that a short switch operation, from 20 ms to 50 ms, could be detected by one function and not by the other, causing a "disagree" fault in one, or indeed in both, channels of the BSCU. The analysis concludes that this in fact happened. The crew saw the "BRAKES BSCU Ch 2 FAULT" message on the Electronic Centralized Aircraft Monitoring (ECAM) display on selection of the BSCU. The message is listed in the Operating Manual as being for "Crew Awareness" and there is no corresponding procedure. It turns out that the crew could have reset the BSCU but this info is not in the Abnormal and Emergency Procedures section of the Ops Manual, but in the Supplementary Techniques section, where it commences with the conditional "In case of braking /steering difficulty..." which they did not have ... because they were still in the air.

What will have then happened is that the hot channel, Channel 2, will have relinquished control to the standby, Channel 1, which will have logged the same fault, but cannot relinquish control since it is operating without a standby. On sensing touchdown ("Weight on Wheels"), four seconds after the spoiler deployment signal, the Autobrake function of the BSCU calls the command function to apply current to open the Normal Selector Valve. The COM/MON disagreement fault becomes a failure; the Normal Selector Valve is not opened, the Autobrake function is lost and the Normal braking system is left inoperative. This is recorded in the CFDIU as a failure in the NSVs (although the actual failure was upstream), yet it is sent to the ECAM as a "BRAKES AUTO BRK FAULT" message, *which is inhibited from display during landing until engine shut down* (but is recorded for post-flight replay). So the crew never saw it — it was not there to be seen.

At the end of the Ibiza overrun area, there is a sea wall and the Mediterranean Ocean. Rather than risk taking a swim, the captain swerved the aircraft from side to side to lose momentum through scrubbing the tires, and then finally managed to achieve 90 degrees of turn, bumping across the grass and into a low bank "to remain within the aerodrome boundary." The report describes the ride as "quite rough."

BSCU software Release 7 was on board; Release 8 provides a fix for the sensing discrepancy condition involved in this incident; Release 9 was released after in-service experience with Release 8. It's not known what release is presently current. But you do get the impression that one hasn't heard the last of the BSCU. It has a low-key habit of not halting one in one's tracks. With triple redundancy you at least get a referee and a fighting chance. With the twin ugly sisters of the BSCU, there's always the chance they'll not be talking to each other, or that one will be down for the count. ✈

The G-UKLL Accident Report is available at: www.mfom.es/ciaiac/publicaciones/informes/1998/1998_019_A.pdf

FAA Moves To Upgrade Black Boxes

In a move expected by many in the aviation community, the **Federal Aviation Administration** (FAA) has proposed a series of significant upgrades to aircraft "black boxes" designed to improve the quality, quantity, and survivability of recorded data. However, it may be many years before such devices are actually in use.

The new proposed rules call for stronger cockpit voice recorder (CVR) and flight data recorder (FDR) standards that require newer recording technology and greater recording frequency. This would ensure that more valuable data can be retrieved from aircraft accidents and incidents.

The new design standards would require all voice recorders to record the last two hours of cockpit audio instead of the currently required 15 to 30 minutes. Also, a 10-minute independent backup power source for the voice recorders would be required to allow recording even if all aircraft power sources were lost or interrupted. Voice recorders also would have to use technology other than magnetic tape, which is vulnerable to damage and decreased reliability.

The **National Transportation Safety Board** (NTSB) welcomed the proposed rules, saying that several improvements to the devices have been on its Most Wanted List of safety improvements since 1997. But NTSB Chairman Ellen Engleman Conners hopes that the FAA will address several of its other crucial flight recorder recommendations that are still on the Most Wanted List. NTSB wants the FAA to act swiftly to rectify the "unacceptable" FDR data sampling and filtering issues that impeded the investigation of the **Airbus** A-300-600 involved in the **American Airlines** Flight 587 accident, Engleman Connors said.

Similar data sampling issues also affect the popular regional jet aircraft. The installation of cockpit image recorders, as recommended by NTSB, would also assist in the investigations of both larger transport category aircraft and smaller for-hire turbine powered aircraft that may not have any existing safety recorders installed, she said.

"The FAA's proposed rule is addressed primarily to flight recorder deficiencies pointed out by the NTSB when it assisted the **Canadian Transportation Safety Board** in the investigation of the crash of **SwissAir** Flight 111 in 1998," Engleman Connors said. "We will carefully review the proposed rule to see whether those concerns have been addressed. I can say that I am gratified that the proposed rule will expand the cockpit voice recorder requirement from 30 minutes to 2 hours, and that independent power supplies will be required to prevent the loss of data if power to the recorder is interrupted during the crash sequence, as occurred on SwissAir.

According to the proposed rule, airplanes, but not helicopters, currently in service would have to retrofit some of the equipment within four years of the rule's effective date. The rule also mandates these enhancements on all newly built aircraft and helicopters two years from the effective date.

The proposed rule affects manufacturers and operators of airplanes and helicopters holding certificates for aircraft with 10 or more seats. The FAA estimates that the total cost to operators and manufacturers would be approximately $256 million in today's dollars. ✈

>>Details of the proposed rule can be found on the Web at www.faa.gov/avr/arm/nprm.cfm?nav=nprm. Contact: Les Dorr, Jr., FAA, (202) 267-3883; or Ted Lopatkiewicz, NTSB, (202) 314-6100, email: lopatt@ntsb.gov<<

Does CRM Need A New Name?

It would seem incongruous (to some) that an institution is now offering a crew resource management (CRM) course that's designated as a single pilot CRM course. From some of the replies it got, (such as "CRM for single pilots is like doing a multi-engine glider rating"), it appears that many people still regard a CRM course to be all about being nice to each other, and could see little relevance for a single pilot (whether instrument flight rules [IFR] or not). So, should there be such an animal and, if so, what could it offer (besides the apparent titling misnomer)?

A modern CRM course covers much more than cooperation, communication and coordination. It has particular focus on the fact that all humans make errors and that many are prone to making poor or ill-considered decisions. There are tactics that can be taught to offset this characteristic and these are relevant to all aircrews. There are also the solitary aspects of situational awareness (SA) and other human/automation/machine interface limitations. Some might see this, for a single pilot, as being the loneliness of the long distance freight-runner pitted O Solo Mio against the triple tyrannies of weather, distance and fatigue.

But has "CRM" outgrown its name? Is the acronym CRM actually preventing the underlying message getting through to those who need it most?

CRM had already been through a name change in the mid 1980s, from "Cockpit" to "Crew" resource management. This was a natural evolution. CRM for single pilot operations could logically revert then to the original title of Cockpit RM.

CRM has undergone some significant changes (Cockpit, Crew, Corporate) over the last two decades. It even gets confused with Customer Relations Management. The initial efforts by NASA in 1978 were aimed at addressing the large number of accidents where "pilot error" was cited as the overall or paramount cause of the accident. But "pilot error," as we all know, can cover a multitude of sins. It became evident that a lack of communication, workload management, poor leadership, loss of SA, and automation-induced reverie were some of the more significant contributing factors, rather than a lack of technical skills by the pilots. This is why Cockpit Resource Management was developed. It filled a perceived need.

Subsequent efforts and research then indicated that other agencies (maintenance, ramp, ATC, cabin staff, etc.) were also very closely involved within the aviation system and this is where Crew Resource Management was developed to address all teams directly involved in daily flying operations. CRM was complemented by LOFT (Line Oriented Flight Training) where aircrew had the opportunity to operate as a crew under simulated flying conditions (in both normal and emergency situations).

CRM has now been tailored to address human factors in many other industries (nuclear, offshore, medical, maintenance, etc.) where "human error" has had a role to play in the actual incident or accident chain. It is easily argued that any accident will normally have a chain of linked events that create a window of opportunity for the accident to occur.

Efforts by Prof. James Reason (1990) gave rise to the concept of the "Organizational Accident," where various levels of the organization and other regulatory agencies subtly create the atmosphere, pressures, environment and ultimately, culture to promote unsafe acts. This then led to people at the sharp end (functionaries such as pilots, doctors, engineers, etc.) committing unsafe acts or violations of acknowledged sound practices.

Due to this approach to human error within complex systems such as aviation, it is argued that "mistake-making" is inevitable and that all personnel are prone to committing some form of unsafe act that will lead to a serious incident or accident. From this vantage point, fifth generation CRM is now seen as "Error Management" whereby errors are either: 1) Avoided if possible; 2) Identified and trapped; or 3) Consequences of error are mitigated to have a minimal impact on the overall integrity of the system (checks and balances).

There is a sixth generation of CRM. Coined in 1999 — the concept of "Threat Management" emerged as being an intrinsic part of the job, coupled with the (5th generation) concept of "error" being an ubiquitous cost of humans being involved in the system.

The latest CRM courses are now all about Threat and Error Management (TEM). The "classical" CRM skills — involving good communication, etc. — are re-labeled as defenses in the pursuit of Threat ID and Error Management.

For an explanation of this evolution of CRM, see www.iasa.com.au/crm.htm. The quick overview highlights some of the subtle changes of the acronym CRM and what the latter day approach is to managing and living with "human error." Other names: Aeronautical (ADM) or Pilot Decision Making (PDM), Pilot Judgment Training (PJT), Crew Coordination Training (CCT). Some prefer to use the traditional codification of "airmanship." But then again, that was the name of the game way back when Pontius was a Pilot. ✈

For further reading, visit: http://homepage.psy.utexas.edu/homepage/group/HelmreichLAB/

● **Safety-Challenged EU Airlines To Be Blacklisted —** European Union regulators have proposed blacklisting EU airlines with poor safety records in a Feb. 16 draft of legislation that would also require tour operators to disclose the carriers being booked for their customers. The disclosure was part of passenger-rights legislation unveiled by the European Commission in Brussels that would also stop airlines from denying reservations or boarding to handicapped or infirm people and bestow to these travelers a right to free assistance both in airports and on planes. The two laws are set to be ratified shortly by the European Parliament and individual EU governments.

BRIEF

These proposals augment EU laws passed last year that allow for the blacklisting of non-European planes that fail safety inspections and increase compensation to passengers for denied boarding and cancellations.

The plan to widen the blacklisting of airlines and force tour operators to identify carriers results from the January 2004 crash into the Red Sea of an Egyptian charter plane bound for Paris *(ASW, Feb. 7, p. 8)*. At least some of the 148 mainly French passengers and crew killed on the Flash Airlines flight weren't informed of the airline with which they would be flying and certainly didn't know that Switzerland had banned the Flash 737-300 plane they were on because of safety concerns. ✈

For more information, see www.iasa.com.au/black.htm.

ACCIDENTS AND INCIDENTS [1]

DATE/SITE	AIRCRAFT & REGN	CIRCUMSTANCES	DEATH & INJURY	PRELIMINARY ANALYSIS[2] imagery at www.iasa.com.au/280205.htm
22 Jan 0950Z Newcastle,UK	MD80 of SAS	Diverted in with reported smoke and fire aboard	Nil/51 pax +6	Headed Manchester, UK, from Copenhagen. Pax coached to MAN
23 Jan Hokitika, NZ	VIP KingAir of NZ Airforce	Results of a very sporty bad weather arrival will be suppressed by RNZAF	Nil	Aircraft carrying NZ PM made numerous attempts to land in very bad weather
01 Feb Paris (Orly)	A320 of Air France	27 y.o. F/A killed when 2L door steps removed by a untrained ramp-worker	1 fatal	Another F/A narrowly avoided a fall
02 Feb ~midnight Ben Gurion A/P, Isr	747-200F of El Al Flt 875	Wheel exploded on t/off leaving large hole in fuselage – so a/c landed overwt	Nil	Tel Aviv. 1.5 meter hole resulted. Cargo was eng for another sick bird
14 Feb St Johns, Newfdld	767-332ER of Delta N187DN	Ex Gatwick UK. Mayday, diversion & emerg landing due to smoke in cockpit	Nil	Flt 59 pax were picked up to continue to Atlanta but divtd JFK due to fog
16 Feb Southern Sudan	DHC5-D Buffalo Reg: 5Y-TEL	Touched down a few feet short & engaged trench dug in the undershoot	Nil	Ex Zambian AF aircraft destroyed
17 Feb 0335Z Van Nuys, Calif.	MU300 of Charlie Air LLC	N150CA ran off the end of the runway on landing	Nil	No damage
18 Feb 0400Z Lubbock, Texas	737 of SWA N394SW	After pax boarded the a/c, door hinge struck due to a jetway malfunction	Nil	Unknown damage
18 Feb 1950Z LAX, Calif.	747 of PAL Flt PAL903	During taxi for departure, struck jetway with left winglet	Nil	Minor damage (was bound LA for Honolulu)
19 Feb 1200Z LaGuardia, NY	A321 x 2 of US Airways	N178US collided with N163US on pushback & both flts were cancelled	Nil/ 168 pax	US1023 to Philadelphia and US335 to Charlottesville (APU cone stove in)
19 Feb ~1700Z Gatwick, UK	777 of Emirates Flt EK040	Diverted in after losing a panel on takeoff from Birmingham	Nil	Panel was inspection cover off #2 engine pylon
19 Feb afternoon Berhampur, India	Beech 200 of Orissa State Govt	Chief Minister's a/c lost a mainwheel on landing at Rangeilunda airstrip	Nil/ 2 crew	Props mangled, some fuselage damage
19 Feb Jammu, Kashmir	737-200 of Alliance Air	Late takeoff abort after explosion and fire in #2 engine	Nil/ 115 pax	Bound for Leh, India (flight cancelled)
19 Feb 1748Z Manston, UK	BAe146 of Flight Line Flt 231	Manston to Dover flight declared an emerg and re-landed with unsafe gear	13 o/b	No damage after a number of touch & go bounces to persuade the faulty gear
19 Feb 0235Z Ogden, Utah	C402 of Western Air Express	N7947Q declared an emerg inbound when crew door came off near Ogden	Nil/ 1 o/b	From Twin Falls Idaho (Landed Salt Lake City, Utah)
20 Feb 1818Z Rifle, Colo.	Gulfstream G200 reg: N516CC	Overshot runway by 400 feet on landing and ended up bogged in mud	Nil/ 3 o/b	Runway braking reported good
20 Feb Manston, UK	Fokker 100 of EUJet	Made a number of TWR flybys with stbd maingear stuck half-deployed	7 crew	Achieved three greens on gear after some touch & go bounces
20 Feb ~1600L Manchester, UK	747-400 of BA Flt BA268	Declared Mayday due fuel shortage (inaccessible gas) and an inability to go around – as it diverted to Manchester	351 pax	#2 engine had failed with a reptd 20ft flame on departing LAX for Heathrow. Flt landed with 2 tons usable fuel
20 Feb 1847Z Garden City, Kan.	737 of Allegheny Air	AAY5201 put its main gear off the taxiway while turning & became stuck	Nil/147 pax +6	Minor damage (FAA report says MD80). Originated Laughlin Nevada
21 Feb 1334L Cherokee City, Ark.	Bell 206L-1 of Air-Evac EMS	Lost power at 250 feet after dept and crashed 2 miles N of Cherokee City	1 dead/ 4 o/b	N5734M opr by Air Evac Lifeteam. 71 y.o. accident patient killed. Ingestion?
21 Feb 1845L New Delhi, India	IL96 of AeroFlot Flt: SU552	Diverted into Indira Ghandi after a cabin pressure problm req'd a descent	Nil/91 pax +20	Bangkok to Moscow flight
21 Feb Stavanger, Norway	737-405 of SAS Braathens	Aborted final apprch to Kristiansand after being hit by lightning + damage	Nil	Oslo to Kristiansand flt experienced some instrument failures due to strike
21 Feb night Bromont A/P, Can.	HS125 of Sky Avn Chicago	N21SA landed 100m left of runway due inop runway lts & wiped the gear	6inj/ 6 o/b	Montreal (Trudeau) to Bromont. Aircraft severely damaged (may be write-off)
21 Feb 2153Z Fairbanks, Alaska	737 of Alaska Flt ASA130	Slid off the runway during taxi-out and hit the taxiway lights	Nil	Unknown damage
21 Feb Heathrow, UK	747 of Virgin Atlantic	VS021 announced a serious problem with #4, dumped fuel and re-landed	Nil	Reverser light caused engine shutdown. Problem fixed & flt deptd
22 Feb 0730L Mararena, Indon.	Casa 212 of Indonesia Police	One eng failed on apprch to this East Papua airfield & it crashed 500m short	15 dead/ 14 +4	Enroute from Papuan provincial capital Jayapura to Sarmi Regency
22 Feb 1343L Bimin West, PNG	Twin Otter of MAF	Weather-related accident during approach to mountain airstrip	2 fatal/ 11 o/b	2 x Missionary Aviation Fellowship pilots killed (both New Zealanders)
22 Feb 0500Z Atlanta, Ga.	737 of Delta Flt DAL1009	While taxiing, the right wing-tip hit a service truck	Nil	Minor damage
22 Feb 2026L Trinidad, Bolivia	Convair 580 of TAM	Crash-landed on mudflats just after t/off - following engine problems	28 inj/ 50 o/b	Turboprop (headed for Cochabamba – J. Wilsterman Airport, Bolivia)
23 Feb 1915L Cedar Rapids, Iowa	CRJ200 of Pinnacle Airlines	Detroit, Mich., to Wichita, Kan., flight diverted in with a cracked windshield	Nil/ 45 o/b	Operated for Northwest Airlink
23 Feb New Haven, Conn.	EMB145 of US Airways	Pilot diverted into Tweed Airport with one failed engine	Nil/ 26 o/b	No further details

[1] Air carrier accidents, or other incidents involving serious failures or fatal injuries, investigated by National Transportation Safety Boards.

[2] DISCLAIMER: These assessments are not intended to assert probable cause or liability, but rather are intended to provide insight pending publication of a final report of investigation. Preliminary analysis by John Sampson - International Aviation Safety Association.(IASA)