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# focus
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# Contents

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**FOCUS** is a quarterly subscription journal devoted to the promotion of best practises in aviation safety. It includes articles, either original or reprinted from other sources, related to safety issues throughout all areas of air transport operations. Besides providing information on safety related matters, **FOCUS** aims to promote debate and improve networking within the industry. It must be emphasised that **FOCUS** is not intended as a substitute for regulatory information or company publications and procedures.

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*Front Cover Picture: Gulf Air Airbus A320 taking off from Bahrain International Airport*

# How do we know when we are good enough?

by Dai Whittingham, Chief Executive UKFSC

**At the recent International Air Safety Seminar in Chile, Harry Nelson, a test pilot and product safety executive for Airbus, observed that the latest generation of fly-by-wire aircraft have an accident rate of 1 per 10 million cycles – the fabled $1x10^{-7}$. He went on to point out that by 2030, current rates suggest we could expect a fatal accident every three months, and asked how we might get the rate down to $1x10^{-8}$.**

Harry is of course correct – we should be looking at ways of driving the rates down further still. Twenty years ago, it would have been a pipe-dream, but now we need to start thinking of $1x10^{-8}$ as a reasonable aspiration for the top end of the market. That said, statistics show that most of our accidents are occurring in the turbo-prop and business jet fleets, albeit the cost per accident in terms of human life is much lower. Incidentally, the EU now prices a single human accidental loss of life at 12 million Euro.

So are we focusing our global safety efforts in the right area? Should we be paying more attention to the less sophisticated operations? Why is it OK in some areas to employ a low-time pilot on a turbo-prop and expect them to operate in often challenging conditions even though the same individual is deemed unqualified where flying a narrow-body jet is concerned? Does carrying an extra 50 passengers really make such a difference? I don't pretend to know the answer to these questions, but suggest there is a political threshold beyond which an aggregate of individual tragedies generates a demand that 'something must be done'. For example, there were 10 fatal GA accidents involving UK-registered aircraft during May-Sep this year; had there been 5 or 6 fatalities per accident, one would expect political calls for action despite the lack of a causative thread between the events. However, what is guaranteed is that the political and commercial thresholds would be crossed where loss of life runs into the hundreds or, heaven forbid, 1000+ for a double wide-body disaster. So there is no question about the need to keep the foot on the safety pedal for the bulk of CAT operations, but we do need to find ways of allowing progress at one end of the market to percolate down to the other.

There is no way we will ever get to a true zero rate for accidents, though $1x10^{-8}$ arguably comes close in today's terms. Technology will help, assuming that it is affordable – and there is an understandable tension between cost and output here. It comes back to the question of what is 'good enough', and that depends on where you sit in your organisation. Despite the various corporate statements that 'safety is our number 1 priority', the reality is that businesses are there to make money. If you are one of those responsible for finances, safety is part of your management overhead, and if you can get away without spending more money on safety than you strictly need to, you will.

The difficulty in arguing the case for more safety spending lies with proving the efficacy of a deterrent – the fact that an event has not occurred may be because the safety defences have operated correctly but it could equally be because the main risks are latent rather than manifest and the accident conditions have yet to occur. In this respect, we need to take care to ensure that we are measuring the right things and getting to that part of the data iceberg that is below the surface. Have we really identified the right risk? Mindful of the overall safety record (which is excellent when compared with most other industries) should we be concentrating on some of the smaller-ticket items such as ramp safety? Does our SMS allow us to tackle the more frequent but less damaging 'slips and trips'?

The severity versus probability matrix can be quite useful in articulating the case for resources when the cost of non-fatal accidents and incidents are factored in. For example, one European operator was recently losing almost 7 million Euros per year through birdstrikes; 15,000 Euro for a no-damage strike soon puts a dent in the profit margin. The aggregation of small events meant the threshold was crossed. The operator opted to invest in equipment and training for local staff at its most birdstrike-prone destinations. Result: fewer birdstrikes, lower costs, happier management. Oh, and improved safety.

So try investing some of your energy in tackling the lower-level safety issues before the aggregate effect forces you to. It may not have an impact on the global safety statistics, but it may just make the difference at local level.

# Improving Communication

By Capt. Neil Woollacott, flybe

**It is apparent that the aviation industry, and in particular the UK, has been making great strides in this important area of Flight Safety. We have achieved a high level of safety awareness throughout the industry, but, I need to emphasize, let us not rest on our laurels- there is still plenty to do.**

Safety awareness is not always enough, there is no point in knowing an accident may happen if we do nothing about it.

The route to achieve good accident prevention programmes and safety management systems has to start from the top. In any industry, if the workers know that the bosses believe in the cause and can communicate the vision of safety, the incentive to achieve is far greater, and aviation is no different. If the MD or Chief Exec believes that safety is a must and is willing to drive that from the top in everything we do, we will achieve high levels of safety in our operations. This is a vital part of an effective safety culture that works.

Maintaining an effective and pro-active safety department takes time and money, the two things that are at a premium in the industry at this time and not easily available! The majority of aviation companies in the UK have safety strategies in place but are they there because of the company culture or because of Regulation? I would like to think that safety culture is the driving force? The quest in the industry for better returns using fewer resources is an understandable attitude, after all, the more money we make, the safer and more secure our jobs are. This must, however, be balanced against a strong safety culture throughout the operation. A little money, well spent, may save millions in the future.

Are we making the most of our available resources during these very tough times? The UKFSC for example has a wealth of knowledge and experience within the committee. Are you making the most of this valuable resource? Communication between us all improves safety and the resource and cost is minimal, however it can make a significant contribution to Flight Safety if we are able to communicate between us all. The UKFSC is able to bring all areas of aviation together, where the main goal is improving safety across all areas.

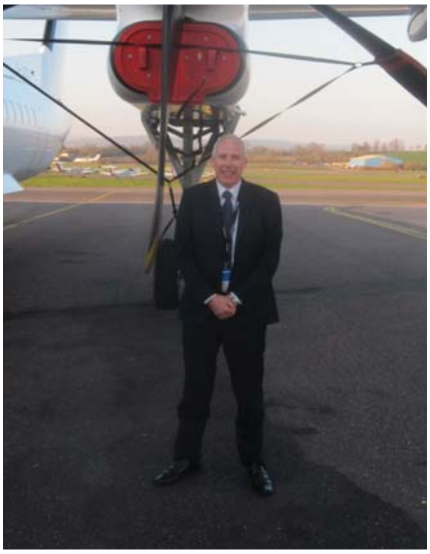
Are you making the most out of your relationship with the regulators? Good honest communication with them will again prove helpful in implementing safety systems and giving guidance on how to achieve the hopefully high safety goal that we set ourselves not just regulatory compliance.

The 1st of January 2005 saw the mandatory introduction of Flight Safety Monitoring (FDM) in the UK for all commercial aircraft over 27 tonnes. For those companies who do not yet have FDM, this probably comes at a time of tight budgets and limited revenue. It should however, if used sensibly (and sensitively!) pay for itself and add considerably to the safety system. For the accountants, let me offer you the incentive of crews following Standard Operating Procedures (SOP's) more carefully thus correct landing speeds will reduce brake and tyre wear, as well as reduced engine component failure and economical fuel burns with accurate cruise speeds. This, of course, is not the only way that money can be saved. Proficient investigation of incidents, recommendations for changes to SOP's and training, poster campaigns and annual refresher training, are a small part of what can be done to add to a sturdy safety system.

So who can save you a lot of this cash? Probably your Flight Safety team.

I make no apologies for repeating myself when I say that the temptation to cut safety budgets should always be avoided. Inevitably the balance between cost and safety has to be a compromise that will keep all sides happy, but this can be achieved through sensible planning and reasonable requests (not demands!) The safety manager with the "must have now" attitude is guaranteed to turn any companies' money tap off!

We haven't had an accident so we must be safe" is, thankfully, not a phrase we hear too much of in aviation these days. But perhaps the thought may still occur to some. Is this the case for you, or have you just been lucky?



## UK FLIGHT SAFETY COMMITTEE OBJECTIVES

- **To pursue the highest standards of aviation safety.**
- **To constitute a body of experienced aviation flight safety personnel available for consultation.**
- **To facilitate the free exchange of aviation safety data.**
- **To maintain an appropriate liaison with other bodies concerned with aviation safety.**
- **To provide assistance to operators establishing and maintaining a flight safety organisation.**

# Landing Distance Assessment
# A Review of Recent Developments

by Cameron Dyer, Flight Data Analyst

**The World Aircraft Accident Summary (WAAS), reviewed accidents involving both eastern and western turbojet and turboprop aircraft between 1995 and 2008. The review found that 30% of aircraft accidents resulting in major or substantial damage were runway related, 97% of the runway related accidents were runway excursions.**

Runway excursions continue to occur where crews have not undertaken a landing distance assessment prior to landing on a contaminated runway. The Federal Aviation Administration (FAA) determined that most runway excursions occur due to either a lack of or nonadherence to standard operating procedure (SOP). This article will review literature as it relates to the imminent introduction of FAA regulation on arrival landing distance assessments.

The following landing distance definitions are from the Flight Safety Foundation (FSF) Approach and Landing Accident Reduction (ALAR) tool kit:

**Actual Landing Distance:** The distance used in landing and braking to a complete stop (on a dry runway) after crossing the runway threshold at 50ft. The unfactored certified landing distance may be different from the actual landing distance as not all factors affecting landing distance are required to be accounted for by FAA certification requirements (25.125).

**Required Landing Distance:** The distance derived by applying a factor to the actual landing distance. The RLD is also known as factored landing distance, operational landing distance and dispatch landing distance.

The following are additional definitions from the FAA Safety Alert for Operators (SAFO) 06012:

**Safety Margin:** The length of runway available beyond the actual landing distance. Safety margin can be expressed in a fixed distance increment or a percentage increase beyond the actual landing distance required.

**Landing Distance Available:** The length of runway declared available for landing. This distance may be shorter than the full length of the runway. This is also known as effective runway length.

## Runway Excursion Accident Scenario

A weather observation prior to landing reported a wind direction and velocity of 110 degrees at 8 knots. Visibility was $^{1}/_{2}$ statute mile with moderate snow and freezing fog. Cloud base was broken at 400ft and overcast at 1400ft, temperature was -3 degrees Celsius. Runway braking action reports were varied with good or fair braking action for first half of the runway and poor braking action for the second half of the runway. While holding prior to landing, updated weather and runway conditions were entered into the onboard performance computer (OPC) to determine landing distance required for runway 31C. When using a fair runway braking action input the OPC calculated the aircraft would stop 560 feet before the departure end of the runway, when using a poor runway braking action input the aircraft would stop 40ft before the departure end of the runway. The flight data recorder indicated that the aircraft touched down on the centreline at 124 knots, within one second spoilers deployed and auto brakes were activated. The Captain reported that the aircraft seemed to accelerate after touchdown and that the thrust reversers would not deploy. The Captain applied manual braking but full thrust reversal was not achieved until 18 seconds after touchdown. At full thrust reversal activation, only 1000ft of runway remained. The aircraft departed runway 31C at 50 knots rolling through a blast fence and perimeter fence before striking an automobile. The Boeing 737-700 OPC assumes that engine thrust reversers will be deployed on touchdown. The National Transportation Safety Board (NTSB) determined the probable cause of the accident was the crew's failure to use thrust reversal in a timely manner to safely slow and stop the aircraft after landing.
touchdown. The National Transportation Safety Board (NTSB) determined the probable cause of the accident was the crew's failure to use thrust reversal in a timely manner to safely slow and stop the aircraft after landing.

## Response

As a result of this accident involving South West Airlines Boeing 737-7H4, N471WN, the NTSB made eight new recommendations within Aircraft Accident Report 0706 (NTSB/AAR-07/06). The recommendation which relates to this article required part 121, 135 and 91 subpart K operators to conduct arrival landing distance assessments before every landing based on existing performance data, actual conditions, and incorporating a minimum safety margin of 15%. The recommendation was coded A-00-66 by the Federal Aviation Administration (FAA) and was added to the NTSB 'Most Wanted Transportation Safety Improvements' in 2007. The recommendation has not yet been incorporated.

The FAA found that operators, at the time, did not have guidance and regulation for addressing aircraft operation on contaminated runways. To evaluate the adequacy of regulations and guidance materials as they relate to N471WN, the FAA initiated an internal audit following the accident. The following issues were identified during a survey of pilot and dispatcher training procedures and flight operations of part 121 turbojet operators:

- 50% of operators did not have policy for determining if sufficient landing distance exists at the time of arrival even when conditions are worse that those planned at the time the flight was released.
- Not all operators who perform landing distance assessments at the time of arrival have procedures, which consider runway surface conditions or reduced braking action reports.
- Not all operators who perform landing distance assessments at the time of arrival apply a safety margin to the calculated landing distance. Operators who do apply a margin are inconsistent in applying an increasing safety margin as the calculated landing distance increased.
- Some operators either developed their own performance data, or use data developed by third party vendors which indicate shorter landing distances than the airplane manufacturers data for the same conditions.
- Credit for the use of thrust reversers in the landing performance data was not uniformly applied and pilots may not have been aware of differences in landing performance data for aircraft of similar type, i.e. 737-300 and 737-700.
- Aircraft Flight Manual (AFM) landing performance data (unfactored certified landing distance) does not reflect required landing distances (the factored actual landing distance).
- Some operators prior to the FAA survey were using unfactored certified landing distances without applying an additional safety margin of 1.67, i.e. factored landing distance = 1.67 x unfactored certified landing distance.
- Current regulations do not specify a particular safety margin for a landing distance assessment at the time of arrival. This safety margin had been left to the operator or flight crew to determine.
- Additional landing distance data (i.e. landing distance data for a range of runway braking action conditions, deceleration devices and meteorological conditions) provided by aircraft manufactures are not standardised or included within the FAA approved AFM.

Outcomes from the FAA internal audit include an advanced notice of policy for *landing performance assessments after departure for all turbojet operators* which was published in the Federal Register in June 2006. This notice considered a 15% margin between the expected actual landing distance and the landing distance available at the time of arrival to be the minimum acceptable safety margin for normal operations. The advanced notice of policy provided the 15% margin the NTSB was seeking in A-00-66 (mentioned above) and went one step further in that it also incorporated all turbojet operators, not just part 121 turbojet operators.

The advanced notice of policy would have been incorporated in October 2006 as Operations Specification / Management Specification (OpSpec/MSpec) C082, however it was the inclusion of additional turbojet operators which prompted public comments including objections from the National Air Transport Association (NATA) and National Business Aviation Association (NBAA) who argued that a notice of proposed rule making, not policy was required by law and that the policy would unduly burden the industry and unnecessarily restrict airport access.

The FAA subsequently abandoned the advanced notice of policy and issued Safety Alert for Operators (SAFO) 06012 in August 2006 and initiated the rule making process to incorporate changes to landing distance assessment as outlined below.

The purpose of SAFO 06012 recommends that all turbojet operators develop SOPs to assess landing distance based on actual conditions at the time of arrival and should incorporate a safety margin of 15% to the actual landing distance (ALD). The SAFO

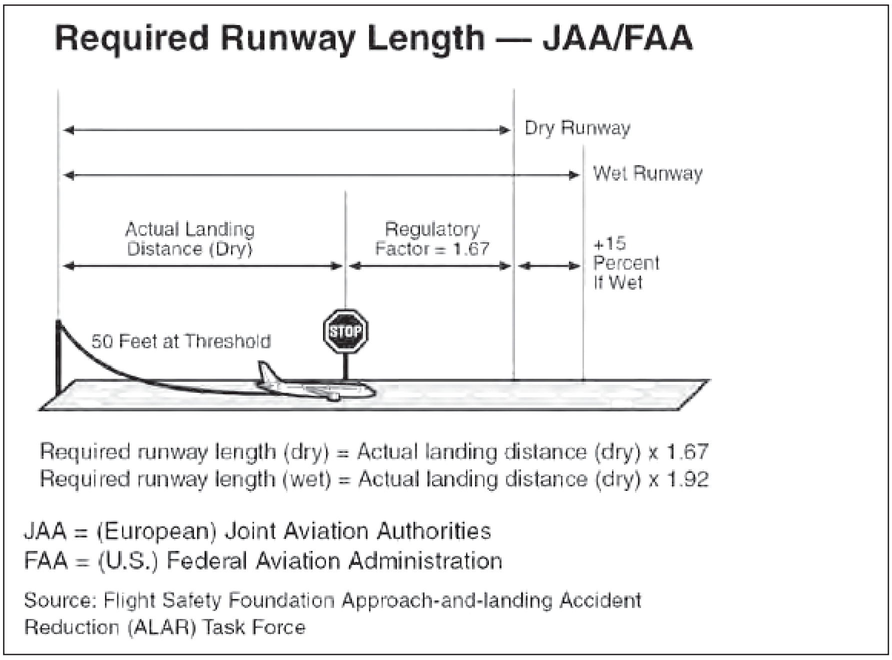



*Figure 1: Required Runway Length – JAA/FAA*

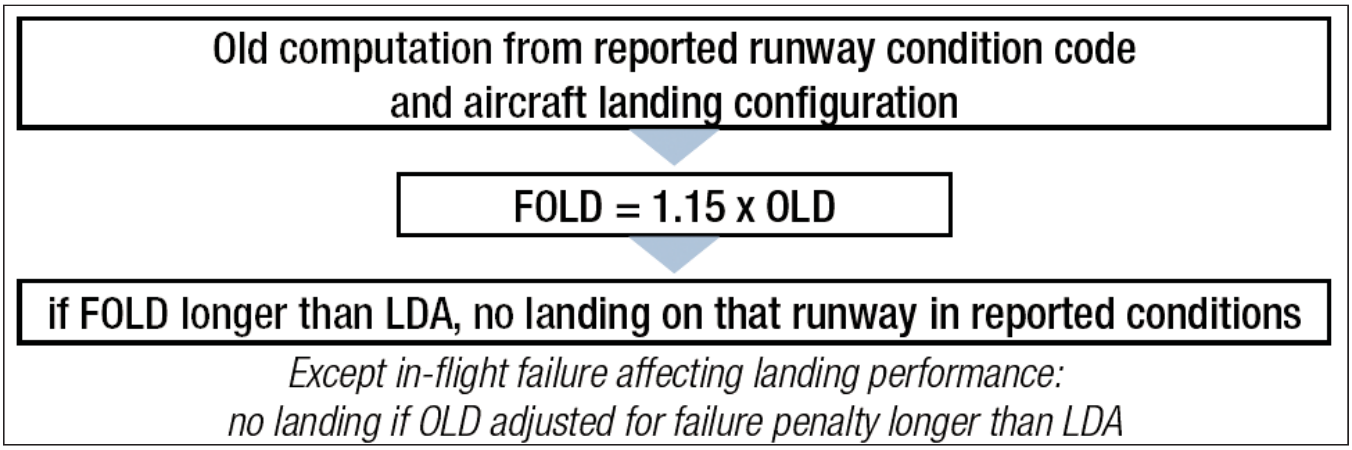



*Figure 2: In-flight assessment of landing distance*

recommendation differs from the NTSB recommendation, in that SAFO recommends a landing distance assessment is not required during each landing, rather the assessment is recommended when conditions at the arrival airport deteriorate. In emergency or abnormal situations, crews may need to determine whether it is safer to remain in the air or to land immediately and must know the actual landing performance capability (without an added safety margin) when making these evaluations.

The FAA asked operators to voluntarily comply with SAFO 06012 pending rulemaking.

Following the promulgation of SAFO 06012, Advisory Circular (AC) AC91-79 Runway Overrun Protection was issued by the FAA in June 2007. The purpose of AC91-79 is to provide pilots and operators of turbojet aircraft with the ability to identify, understand and reduce risks associated with runway excursions during landing and to assist with the development and implementation of related SOPs. The AC outlines hazards associated with runway excursions:

- A nonstabilised approach, i.e. late landing configuration, high descent rate, high indicated airspeed, unsuitable engine speed.
- Excess airspeed.
- Landing beyond the intended touchdown point.
- Failure to assess required landing distance based on conditions at time of arrival.

AC91-79, like SAFO 06012 recommends that operators develop SOPs for assessing the required landing distance based on conditions which are known to exist at the destination airfield. Operator's should use either factored landing distance or apply a safety margin to the unfactored landing distance when assessing required landing distance at the time of arrival. The AC does not specify a safety margin and comments that it should not be confused with regulatory pre departure runway requirements and that the 15% recommended by the FAA only accounts for slight variations in performance.

Following promulgation of AC91-79, the FAA established the Takeoff and Landing Performance Assessment Aviation Rulemaking Committee (TALPA ARC) in December 2007 with representation from the FAA, aircraft manufactures, airlines, airports and regulatory authorities. The objective of TALPA ARC is to provide a forum for the U.S. aviation community to discuss recommendations from SAFO 06012 and although not related to this article, takeoff performance from contaminated runways and issues relating to the certification of part 139 airports.

TALPA ARC finalised its proposal for new regulation of in-flight landing distance assessments in July 2009. Proposals included standards for runway condition reporting (FAR139), definitions for operational landing performance calculation (FAR25/26) and operational rules (FAR121). TALPA ARC determined that the required landing distance, in certain situations will have an insufficient safety margin. TALPA ARC state: "This is why an inflight landing performance assessment will be required to be made systematically as part of the approach preparation".

## Outcome

FAA part 121 operational rules will mandate a safety margin of 15% as recommended by the NTSB, SAFO 06012 and proposed by TALAP ARC. The 15% safety margin is applied to the operational landing distance (OLD) which then becomes the factored operational landing distance (FOLD). FOLD is equal to 115% of OLD. FOLD will remain at 100% if an emergency or in-flight failure exists.

The 15% increment provides a safety margin for variability in runway friction including precipitation and rubber build-up, flare technique, deceleration technique (i.e. timely activation of thrust reversal, spoilers, brakes etc..) and touchdown speed.

An in-flight landing distance assessment will not be required if:

- at the time of dispatch the runway condition is DRY (or worse) and at the time of approach preparation the runway condition is DRY and no conditions other than standard flight dispatch conditions are reported.

OR

- the runway condition at the time of despatch is WET (or worse) and at the time of approach preparation the runway condition is WET and no other conditions other than standard flight dispatch conditions are reported if the landing runway is maintained in accordance with AC150-5320 (the runway is grooved or Porous Friction Course).

*American Airlines Flight 311 landed 4100ft into an 8900ft runway in heavy rain.*

TALPA ARC submitted its proposals for in-flight landing distance assessments to the FAA in May 2009, the FAA may publish a NRPM in early 2011 which will be followed by a mandatory comment period of six months. It is unlikely that in-flight landing distance assessments will be legislated before the end of 2011. The TALPA ARC proposal includes a two year grace period for operators. It could be late 2013 before all FAR part 121 operators are required to comply with in-flight landing distance assessments.

Currently FAA and European Aviation Safety Agency (EASA) regulation regarding landing distance assessment at the time of arrival do not provide guidance on criteria and factors to be considered in landing distance assessments.

## Landing Performance Calculations at Air New Zealand

The Air New Zealand Standard Operating Procedure (SOP) committee is developing landing performance calculation policy which is currently being reviewed by Fleet Managers. The aim of this policy is to give crews some general guidance on when they should consider completing a landing performance calculation as well providing specific "must do" trigger values for specific fleet types.

## Conclusion

Hopefully this article has provided some insight into the developments in legislating the requirement for crew to conduct a landing distance assessment when conditions at the destination airfield have changed during flight. The Air New Zealand SOP committee is developing landing performance calculation policy which will help reduce the risk associated with the approach and landing of Air New Zealand aircraft.

## References


Airbus (2010). Flight Operations Information Letter: In - flight landing performance assessment: D10023751.

Flight Safety Foundation. (2000). Approach and Landing Accident Reduction Tool Kit: FSF ALAR Breiding Note 8.3 – Landing Distances. Flight Safety Digest: August – November 2000.

Kornstaedt, L., Lignee, R. (2010). Operational Landing Distances: A new standard for in-flight landing distance assessment. Safety First – The Airbus Safety Magazine: Issue 10 – August 2010.

National Transportation Safety Board (2010). Most Wanted Transportation Safety Improvements: Federal Issues – February 2010.

National Transportation Safety Board (2007). Runway Overrun and Collision, Southwest Airlines Flight 1248, Boeing 737-7H4, N471WN, Chicago Midway International Airport, Chicago, Illinois, December 8, 2005. NTSB/AAR0706.

Rosenkrans, W. (2007). Knowing the Distance. Aero Safety World – February 2007.

Rosenker, M. V. (2006). Margins of Safety. Aviation Safety World – December 2006.

Takeoff / Landing Performance Assessment Aviation Rulemaking Committee (2009). TALPA ARC Airport / Part 139 Working Group Recommendation. Recovered from: http://www.glcaaae.org/documents/news/TALPA_ARC_Working_Group.pdf

U.S. Department of Transportation Federal Aviation Administration (2007). Runway Overrun Prevention. AC91-79.

U.S. Department of Transportation Federal Aviation Administration (2006). Landing Performance Assessments at Time of Arrival (Turbojets). SAFO 06012.

U.S. Department of Transportation Federal Aviation Administration (2007). Takeoff / Landing Performance Assessment Aviation Rulemaking Committee. Order 1110.149.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# The Future of Freight

by John Frogatt, Cargo and Commercial Bid Director, Manchester Airport Group

**The revenue stream created by cargo is an important one for airports. Mark Glover from International Airport Review spoke to John Frogatt, Cargo and Commercial Bid Director at the Manchester Airport Group (M.A.G) about the importance of the market and how it affects the group's circle of airports which includes Manchester, East Midlands and Bournemouth.**

**Mark Glover:** *In December 2012, the Transportation Security Association (TSA) will be introducing regulations that will mean 100 per cent screening of all international cargo. How will this affect your security procedures and ultimately, your efficiency?*

**John Frogatt:** Security is important for all of us. I believe that an important step forward has been taken in that the U.S Transport Security Administration and the European and Canadian regulators have now agreed to recognise each other's procedures, which should reduce duplication and ultimately cost and delay.

**MG:** *What markets are the most important at the moment and which countries do you feel will start to emerge over the next five to 10 years?*

**JF:** Asia, particularly China, along with the USA, are important markets at the moment, particularly for Manchester Airport. The impact of the Gulf-based carriers such as Emirates, Etihad and Qatar Airlines-which operate triple daily, double-daily, respectively-with their increasingly large bellyhold uplift and network capability to serve a range of markets, a model which Singapore Airlines has operated for many years, cannot be underestimated. Looking further ahead, air cargo flows ultimately reflect wider economic trends. If as forecast, development in Asia moves, both within China to areas further west and south, then to Vietnam and perhaps ultimately Africa, these areas will become increasingly important – along with some of the other major growth economies, such as India and Brazil.

**MG:** *How important are the relationships you foster with the global airports and what are the key elements that you look for in a partnership?*

**JF:** As customers or potential customers, our most important relationships are with airlines, together with the other serious players in the flow of cargo, such as the freight forwarders. Airports compete for airline traffic, although this is driven largely by geography; however all airports tend to share common issues and problems, which can be improved or mitigated by dialogue. From a wider perspective, M.A.G recently signed a sister agreement with the second largest airport in the world, Beijing Capital International, to exchange ideas on strategy, operations, sustainability, security and future development. Looking into the future, partnerships such as this may help us to better understand the requirements of, for example, Chinese airline customers, or best practice sharing.

**MG:** *In terms of an airport's revenue, how important is the cargo sector and how can this revenue be maintained?*

**JF:** Cargo is a significant contributor to revenue, particularly at East Midlands Airport, which is the number one UK airport for pure cargo. We are constantly seeking to develop new services with potential customers, but we also work closely with our real estate colleagues to maximise the potential for ancillary revenues, which are driven ultimately by the success of each airport as a cargo operation. At Manchester, the £650 million Airport City project will add 1.4 million square feet of new state-of-the-art logistics space, with fully integrated air-to-road transfer capabilities, over the next decade. We believe this will be a very attractive proposition, not just for logistics operators, but also for airlines which are perhaps considering entering the UK market.

**MG:** *Your UK locations in Manchester and the East Midlands are important; logistically what benefits do these locations bring?*

**JF:** East Midlands Airport is located pretty much in the centre of the country with around 90 per cent of England and Wales within a four-hour drive, which makes its location extremely well placed for airlines wishing to serve the country from one location. This is a factor that has not gone unnoticed by the integrated carriers, with DHL, UPS and TNT, as well as Royal Mail, all having significant operations at the airport. In a similar way Manchester Airport is very well situated to serve the North of England, with a

## TSA announces cargo screening deadline

The Transportation Security Administration (TSA) has announced it has set a deadline for passenger air carriers to conduct 100 per cent cargo screening on international flights bound for the United States. From 3 December 2012, all cargo shipments loaded on passenger aircraft must undergo screening for explosives, fulfilling a requirement of the Implementing Recommendations of the 9/11 Commission Act.

TSA has worked closely with other governments, international organisations, and industry partners to increase the security of air cargo without restricting the movement of goods and commerce. The screening deadline announced requires 100 per cent screening of all air cargo shipments bound for the U.S. It builds additional risk-based, intelligence-driven procedures into the pre-screening process to determine screening protocols on a pershipment basis. This process requires enhanced screening for shipments designated as higher risk, while lower risk shipments will undergo other physical screening protocols. "Harmonising security efforts with our international and industry partners is a vital step in securing the global supply chain," said TSA Administrator John S. Pistole. "By making greater use of intelligence, TSA can strengthen screening processes and ensure the screening of all cargo shipments without impeding the flow of commerce."

These risk-based security efforts are one aspect of the Administration's recently announced Global Supply-Chain Security initiative. Currently, all cargo on passenger aircraft – both domestic and international – departing U.S. airports undergoes screening. Domestically, cargo screening is conducted by air carriers or those voluntarily participating in the Certified Cargo Screening Programme, under strict regulatory oversight of TSA. TSA has more than 500 inspectors throughout the country to ensure compliance with air cargo security regulations. In addition to its domestic inspector workforce, TSA has more than 100 internationally-focused inspectors who assess and document security measures at applicable foreign airports.

TSA will continue to work with other governments, international organisations, and industry partners to strengthen air cargo security by putting more risk-based and intelligence driven procedures into the screening process. **www.tsa.gov**


*Cargo is a significant contributor to revenue*

catchment area that extends coast-to-coast, North to Scotland and South to Birmingham. Connections to Ireland from Manchester are strong too.

We always approach potential customers with an open mind as ultimately we want them to operate from one or more of our airports across the UK, depending on which best suits their requirements, with each airport's attributes offering different solutions. For an airline looking to operate a freighter into one location in the UK, East Midlands Airport's central location is clearly the best match. Or if an airline already operates into London or the South East, a second service into Manchester Airport provides improved delivery times to the North West, Midlands and Scotland, complementing the South East service. On the other hand, if a customer requires access to the UK but for whatever reason needs to minimise flying time, for example pilot hours, then Bournemouth Airport can provide a solution with easy access to London, less than 100 miles away. There is always flexibility and we can share our advice, but ultimately it is down to the customer to decide which airport works best for them.

**MG:** *How efficient is the Border Inspection Post and what particular challenges can the inspection process bring?*

**JF:** We view the Border Inspection Posts at Manchester and East Midlands Airports as part of the infrastructure, which provide current and future customers with options for importation of animal products from outside the EU. The processes are heavily regulated; as for example is the layout and facilities they contain. Again our approach is driven heavily by customer demand, as is further investment in new or specific facilities.

**MG:** *How important is the relationship with the logistic provider companies?*

**JF:** We work on the basis that the more we know about what is important to our customers, the more efficient and effective our service to them becomes. The integrated carriers such as DHL, FedEx and UPS are major players in the logistics industry and bring their own demands in terms of the importance of on time departures to their networked operations. This means little or no slack in their block times compared to passenger services, and their worldwide network connectivity means that issues, such as the time taken to clear the runway and aprons after snow, assume new significance.

We recognise that everyone generally wants everything immediately and for the lowest possible price, that's just human nature.

However, this is where establishing and building on strong, long-term relationships can help us to go one better in achieving this, enabling us to better understand our customers businesses, their processes and operations. It is also important to acknowledge that no two companies are exactly the same, so it is a balancing act.

The strong relationships we retain enable us to identify what is desirable but lower priority and conversely, what is an absolute must have or game changer for each of our customers.

**MG:** *How do you approach the issue of the environment with your cargo operations?*

**JF:** As a large company, our aim is to balance our operation with careful consideration of the environmental impact we have and most importantly, actively reduce this impact. Our plan to reduce carbon emissions remains on target and our commitment to have carbon neutral ground operations at East Midlands, Humberside and Bournemouth Airports by 2012 and Manchester Airport by 2015 is also on track to being achieved.

We know that we can only succeed if we engage with our stakeholders and we are continually looking to understand what matters most to them. I think the key is to continue a real dialogue, for example, we want airline customers to understand what is important to local people and for local people, who may have concerns, to have a good understanding of our operation.

Environmental issues used to focus largely on noise and the impact of aircraft operations on communities near airports. We know from experience at East Midlands Airport, which is one of the busiest airports at night, that night flying is a particular concern for local residents, so we developed a range of measures designed to enable our customers to fly a considerable number of aircraft at night, but to ensure that they do so in ways which minimise the impact they make. Over the last few years wider issues such as climate change have increased in importance but that does not mean that noise has gone away, in effect we have to consider both.

In reality taking a balanced approach to environmental measures often deals with both noise and wider environmental issues at the same time and can make good business sense as well. For example, working with airlines to maximise the use of continuous descent approaches which reduce noise on the ground and save the airline fuel and thus money and reduces $CO^2$.

## Biography

Originally from a property (real estate) background, John Frogatt has been involved with airports since 1983, mainly at East Midlands Airport from its original Local Authority ownership through its sale to National Express and subsequent resale to Manchester Airports Group in 2001.

With this background he set up the EMA property department and for many years was responsible for property, planning and concession development.

His involvement in the property aspects of the air cargo customers, culminating in the development of the DHL hub at EMA in 2000, led to greater involvement in the air cargo business at EMA and he is currently responsible for the cargo business across all of the M.A.G. airports including Manchester, EMA and Bournemouth.

***Reprinted with kind permission of International Airport Review, Volume 16, Issue 4, 2012.***

# A recipe for better airport operations

by Dr. Christoph Martin Meier, Head of the Aviation-IT Department at Siemens AG

*In the world of airports, Siemens' references include the baggage handling control room in Incheon, South Korea*

**For airport operators all over the world, cost-efficiency, environmental protection and passenger comfort are at the top of the agenda. However, due to the complexity of everyday airport operations, achieving these goals does not rest on just one stakeholder. Instead, all stakeholders must pull in the same direction. An Airport Operations Control Center (APOC) provides all parties involved in airport operations with the same information. The result: improved overall situational awareness and decision-making quality. Siemens' year-long experience with control centers and its software expertise make it the perfect partner for the installation of an APOC.**

***"By nature airport operations are complex. On the day of operations, the many business processes related to aircrafts, passengers, baggage and cargo are handled simultaneously by different stakeholders."***

By nature airport operations are complex. On the day of operations, the many business processes related to aircrafts, passengers, baggage and cargo are handled simultaneously by different stakeholders. In order to enable smooth and efficient operations, seasonal and daily flight plans are prepared, agreed upon and approved by the stakeholders. Obviously, the different processes and decisions that have to be made are far from being independent.

Nevertheless, collaboration among the different stakeholders at an airport is rare. Each stakeholder has different interests, priorities and preferences. This becomes all the more evident when, on the day of operation, a whole range of new aspects and constraints often emerge, for example resource outages, capacity drops, changed airline preferences, different passenger behaviour, etc.

The result is often enormous delays and wasted resources. According to the EUROCONTROL performance review report, air traffic delays cost around €1.5 billion a year in Europe alone. In other parts of the world, the impact is similar. It soon becomes evident that what is most needed is a quick and structured operations control center so that stakeholders can first deal with unplanned events as effectively as possible – and then return to normal operations. The ideal operations control should also make it easy for agents to interact with one another.

## Video wall for the big picture

The main task of an APOC is to ensure common situation awareness. The APOC can be set up either as a central physical location or as a decentralised solution. As a physical location, in either a dedicated building or a room, the APOC is equipped with a video wall that reflects the overall situation. Along with the current time and traffic details, the following information should passively appear on the video wall for the coming three to six hours:

- Flight overview, including process milestone information.
- Weather and other dominant factors, e.g. resource outages that will impact airport performance.
- Capacity demand charts showing the degree of resource usage and the potential congestion and queues.
- KPI charts with the performance of the entire airport.
- Overall airport resource usage strategies.

The agents responsible for individual airport operations should each have working positions in the APOC. From these positions they are able to access more detailed information to make tactical decisions. Depending on the area of responsibility, the agent may see a detailed analysis of passenger flows in the terminal, or baggage system status and the predicted load over the next hours. From the working stations the stakeholders are able to communicate with their back offices and quickly access negotiation support systems to come to joint decisions with other stakeholders.

Naturally, one big advantage of the physical APOC is the possibility for direct, human-to-human communication, which is especially useful in handling exceptional cases. The integration of meeting and discussion spaces in the APOC supports this collaboration.

As a decentralised solution, an APOC virtually connects all relevant stakeholders and decision makers with shared information, communication infrastructure and concerted collaboration processes. A stakeholder's individual role determines which concrete IT systems are integrated. For example, an airline agent would very likely be given access to the transfer passenger display. But whether a centralised or decentralised setup is chosen, Siemens draws on its extensive experience with control centers.

*Dubai Police Headquarters features a control room by Siemens*

## Everything under control

All over the world, control centers from Siemens help keep operations running smoothly. Metro Kaohsiung in Taiwan, the New York Metro Control Center, Hannover's Traffic Management Center and the Energy Distribution Control Center in Azerbaijan are just a few examples of organisations that profit from Siemens' solutions for control centers. In the world of airports, references include the Terminal 4 operation center in Madrid Barajas, operation centers in Bangkok, Hyderabad and Bangalore, as well as the baggage operation centers in Munich, Milan Malpensa and Beijing Capital Airport.

Siemens takes over the entire planning of a control center starting with the operational concept and up to the design for the room and working positions as well as the video wall. For implementation of a control center, Siemens aids with the smooth transition from, the 'as-is' situation to the new concept. Assistance with proactive change management helps ensure buy-in from the different stakeholders. For the 'nervous system' of the control center, Siemens offers a range of IT solutions.

First and foremost, IT solutions increase situational awareness with direct and aggregated process information either on desktops, video walls or handhelds. Agents are shown among others the radar and Advanced Surface Movement Guidance and Control System (A-SMGCS) screens, flight plans, resource plans and operating strategies. External constraints like weather, facility status, system health and fault status can also be accessed.

*Public transport in New York and many other cities is monitored in control rooms*

IT also covers communication systems for interaction within the control room and with remote operations control locations – via phone, message systems, video conferencing and more. Siemens' expertise also covers prediction solutions to mitigate problems pro-actively, for example, capacity prognosis and impact to flights. Situation diagnosis records lessons learned for continuous improvement.

Guidance through difficult operational conditions is accomplished with assistance and optimisation systems – similar to car navigation systems. Workflow management systems streamline co-ordination, breaking down plans into tasks and actions. Finally, IT for document management ensures that all stakeholders can rapidly access the data they need.

All of these IT solutions make a substantial contribution to the success of control centers from Siemens, yet for APOCs the most interesting IT innovation may very well be the Total Airport Management Suite (TAMS). TAMS is an open modular software suite that Siemens developed in the framework of a consortium project supported by the German Federal Ministry of Economics and Technology (BMWi).

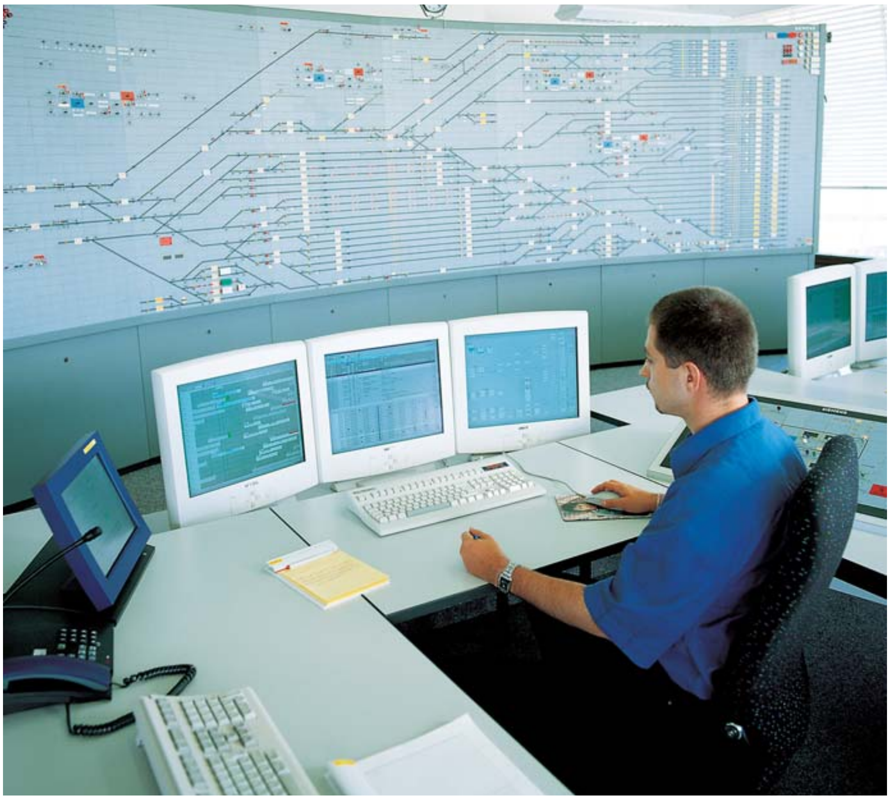
## TAMS – the future of airport operations

With TAMS, Siemens has developed the world's first integration platform for airport IT. TAMS provides seamless support for typical airport processes: from seasonal flight scheduling, daily flight schedules and resource management right through to statistics, reporting and billing, as well as Collaborative Decision Making (CDM) and the TAMS Airport Operations Plan. The platform links the TAMS partners' tactical arrival, departure, surface, turnaround and passenger management systems with Siemens Airport Performance Management applications – as well as with video wall visualisation and workflow management in an APOC.

TAMS has undergone a simulation at Stuttgart Airport, Germany's seventh busiest airport with nine million passengers per year. The results of the TAMS simulation speak for themselves. The punctuality of all flights was improved, which significantly reduced the number of passengers who missed their connecting flights. A further highlight was the 30-second reduction of taxi time for each aircraft. With over 135,000 flight movements in 2011, that adds up to a substantial amount of fuel and avoided CO2 emissions. A portable demonstration model has been developed to provide a realistic simulation of TAMS sub-system functionality.

## A new form of infrastructure

That an APOC carries definite advantages is clear. But at whose initiative can an APOC be introduced? The most suitable stakeholder here is the airport authority. The airport authority is usually expected to provide the basic infra structure of an airport like runways, taxiways, terminals, power and fuel supply, and security – as well as the basic operations infrastructure like flight planning and resource allocation. As such, the airport authority is seen as the perfect stakeholder to introduce and operate an APOC, which can be viewed as a new, modern form of operations infrastructure.



*Ergonomic workplaces are part of all Siemens control rooms like the one installed for the cargo facilities of Deutsche Bahn ©Siemens*

The business case for an APOC is convincing: improved airport productivity – which saves money, protects the environment and leads to increased passenger comfort.

## APOC, AOCC or AOC?

APOC stands for Airport Operations Control Center. Sometimes the concept is also referred to as AOCC (Airport Operations Control Center) or AOC (Airport Operations Center). In Europe, the industry has agreed to use the acronym APOC for this type of control center.

## Biography

Dr. Christoph Martin Meier has been Head of the Aviation-IT Department at Siemens AG since 2009. He has been the overall Project Manager of the Total Airport Management Suite (TAMS) R&D Project and was the leader of the Baggage-IT-Strategy Team at Heathrow Airport.

Dr. Meier has a PhD from the Technical University of Braunschweig and currently lectures at the Technical University of Berlin on 'Human Engineering in Flight Guidance'.

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# Effective Upset Prevention and Recovery Training – Can We Finally Look Ahead?

Dr. Sunjoo K. Advani provides an update on the work of the International Committee for Aviation Training in Extended Envelopes (ICATEE).

**Hindsight is a wonderful thing. If only we could always tum it into foresight. In terms of safety, aviation flies in a sky that is predominately clear and blue. Technology has drastically reduced threats in areas such as Controlled Flight into Terrain and Traffic Collision Avoidance. However, the relative number of incidents due to Loss of Control In Flight, or LOC-I, has not changed, making this the current number-one commercial aviation safety threat. Technology alone cannot solve this problem - integrated, mandated UPRT is the key.**

## Hindsight in LOC Incidents

Much can be learned from examples. A Q400 reducing power to descend, approaching a stall, with airspeed continuing to drop. At a critical angle-of-attack, with the airplane's protection systems announcing imminent danger, the perhaps startled crew continues to bring the aircraft into a fully-developed stall. The wing drops in the opposite direction to pilot input. They appear to attempt to maintain altitude, thereby further increasing angle-of-attack; they never recover.

Weeks later, a 737-800 is on approach, the crew is unaware of a malfunctioning radio altimeter (causing the engines to maintain their "retard" position), and entering the glide slope "hot and high". As the airspeed is bled off, the aircraft enters a stall, and the crew is unable to recover in time.

Other examples include a CRJ on a ferry flight that stalled at FL410. The crew made several mistakes including improper stall recovery techniques. This is similar to an MD-83 that stalled at FL330 over the Caribbean. In both of these accidents there were secondary stalls which complicated the situation. Unfortunately, both aircraft and all occupants were lost.

Some modem airplanes have complex autoflight systems. This has resulted in conflicts between the pilot and the autoflight system. In a few cases the autoflight system has trimmed the nose up responding to pilot inappropriate yoke input.

When the airplane executed a go-around, the nose-up pitch caused by the engines and the nose-up trim resulted in a stall.

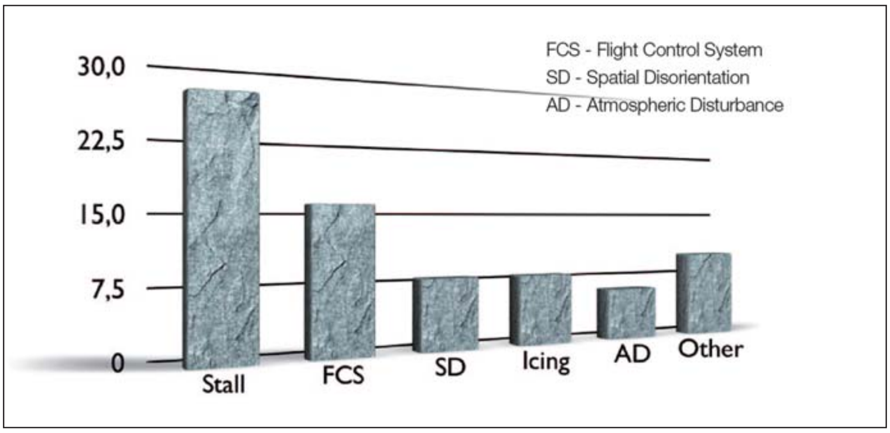
As an industry concentrating on improving training, we ask ourselves, what could possibly be done to prevent the recurrence of such incidents? How can we teach proper avoidance strategies, and if necessary, recovery techniques. What constitutes effective upset prevention and recovery training?

The challenge is to find a common casual thread, and define an effective solution.

## The ICATEE Approach

The Flight Simulation Group of the Royal Aeronautical Society agreed to find solutions by creating the International Committee for Aviation Training in Extended Envelopes (ICATEE). It is now over seventy members strong , with airframe manufacturers, airlines, aviation authorities/safety boards, simulator manufacturers' training providers (including upset recovery specialists), research institutions, and pilot representatives.

ICATEE has concluded that the only way to define training solutions is to first clearly delineate the training needs. The inflow of pilots with exposure to an all-attitude, all-envelope flight environment is rapidly declining as the availability of airmen with prior military exposure or similar civilian experience is decreasing. Experience with high angles-of-attack, increased g-loading, rapid maneuvering and situations that could induce spatial disorientation can be of benefit to recovering from potential upsets in transport category aircraft.




*Numbers of LOC-I incidents , 1993-2007. Image credit: Author.*

### No "Silver Bullet" Solution

Today, we simply do not adequately train pilots consistently to recognize, avoid, prevent and recover from upsets. Practical test standards for stall training that have emphasized "minimum loss of altitude" (even when altitude loss is not a factor) may be leading to negative training transfer when recovering from these threats.

Upset prevention and recovery involves three distinct and critical levels of mitigation. First, there is awareness, which includes a thorough understanding of aerodynamics, and knowledge of airplane upset causes. Secondly, in the event a threat begins to emerge, the pilot must use recognition and avoidance techniques in order to stay clear of the threat, without further compounding the situation. However, distractions, failures, or other factors can still lead to an actual upset; hence, the final hope is to accomplish an effective recovery to bring the airplane back to a controlled state. In some situations with large transport aircraft, such as the incipient spin, or worse - a fully-developed spin, recovery may not even be possible, making recognition, avoidance and prevention the most critical training elements. To train all three, a combination of academics and practical skills development is essential.

For academic training, there exists today an industry-developed guide book called the Airplane Upset Recovery Training Aid. Unfortunately, it is not commonly integrated into training, and its use is not mandated. Furthermore, this aid is limited to large (100 - plus passenger) swept-wing jets, whereas these problems also occur in regional aircraft, including turboprops.

### Practical Training

Aerobatic-capable aircraft, or specially configured aircraft, can teach maneuvering skills and exposure to an all-attitude all-envelope environment. Familiarization with the limit loads and general flight dynamics can be very effective. The transfer of these skill sets to the multi-crew, glass cockpit, automation enhanced environment takes place outside the actual in-flight lesson through a process of "differences training". Flight simulators and academics can act as the bridge between basic skills, and application in the type-specific environment.

Clearly, it is not practical to teach UPRT in actual transport aircraft. Simulators (the logical replacement) are limited to the data acquired from the actual test aircraft. They cannot replicate the forces (g-effects) encountered in upset conditions, nor can they easily generate the sudden startle effect that occurs when a pilot discovers there is little time to apply life-saving control actions. The NTSB has identified several aircraft upset accidents in which inappropriate use of the simulator, and lack of instruct or knowledge could have contributed to resulting accidents.

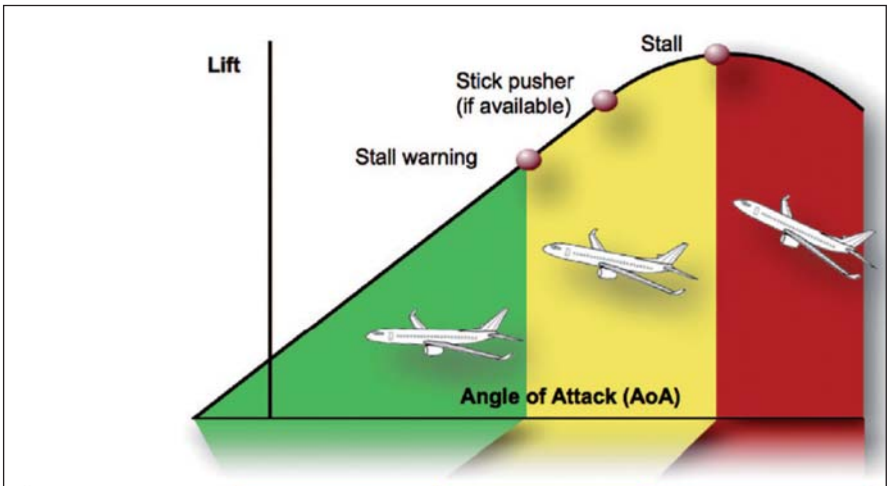
### Simulator Enhancements

What can we do in today's simulators and training curricula to better manage UPRT issues? Many factors have to be considered. Current flight simulator data can lead the pilot into believing that the aircraft remains docile and controllable at all times, even when it may not be. Enhanced data (derived from actual aircraft, or simply "representative") can help pilots in becoming aware that, while initiating recovery of a stall, a roll control reversal, for example, or other effects could be encountered. Experts in ICATEE also agree that enhancements, albeit not even type-specific, may be a major step forward. Fortunately, with the involvement of research organizations like NASA, UTIAS and several academic experts, we will have the advantage of being able to extend existing models, and carry out more detailed analyses before drawing final conclusions.

### Why Train in the Stall Zone?

Proposed FAA rule changes will require pilots to train avoidance and recovery from stalls, and are intended to contribute significantly to reducing LOC-I accidents. As stated in USA Today (11 May 2011), when referring to the Colgan Air 3407 crash, pilots are currently trained to avoid entering a stall at all costs but are never shown how to recover once they have entered a stall. "One key to preventing such accidents in the future will be more realistic training in simulators, according to FAA Administrator Randy Babbitt".

Still, why would a pilot need training beyond the stall warning? Colgan Air, Turkish Airlines, West Caribbean, Pinnacle, West Caribbean, and even a near accident of a USAF C-5A, all




| Training value | Normal Flight | Approach-to-stall | Stalled |
|---|---|---|---|
| Longitudinal control | Awareness or flight envelope, recognition of stall warnings, avoidance of stall | Recognition, avoidance and recovery by reducing AOA | Recovery by immediate reduction of AOA; additional AOA reduces lift |
| Lateral control | Awareness of effects of maneuvering on stall speeds | Avoidance of excessive lateral control inputs | Awareness of potentially complex lateral handling during recovery |
| Power | Little impact on upset prevention | Depending on aircraft class, may further increase AoA | |
| Current Simulator Capabilities | Available | Generally available | Requires additional development |

*As the angle-of-attack increases beyond critical, the characteristics of the airplane can change significantly. Image credit: Author.*

occurred with the stick shaker activated, with plenty of opportunity to recover, and where timely stall intervention did not occur. Inattention, inadequate or improper use of automation were also cited as causal factors. Therefore, exposing pilots to the general nature of these conditions is absolutely essential.

What psychologists call "startle" can affect the pilot's decision-making capabilities and narrow his/her reactions down to basic primal instincts; it is in these conditions that the rote leamed or first-reflexes are applied. In some cases, the initial reaction has proven wrong, and the time available for corrective action is limited.

Currently, simulators provide limited feedback regarding the condition of the airplane close to or inside an upset condition. In today's practice, trainees regularly exceed the aerodynamic, structural, or aeroelastic envelope, as this is not displayed in the simulator. Providing this important feedback to the pilot and instructor could be a straight forward enhancement.

## ICATEE Industry Implementation

Through a comprehensive training needs analysis, ICATEE has been able to define the training objectives, needs and means. There is no one single place or environment where complete upset prevention and recovery training can be conducted. Integration and standardization of multiple resources in a properly structured manner is the key. By properly integrating academics, aircraft training, and simulator training, commercial aviation will achieve the maximum reduction in LOC-I related accidents.

Integrated UPRT is being embraced by major airlines. Recently, KLM Flight Academy announced it has mandated a module of UPRT to participants in its airline transport pilot program, using academics and aerobatic-capable aircraft provided through Phoenix-based APS Emergency Maneuver Training. Both organizations are ICATEE members.

ICATEE has already provided support to the FAA/Industry Stall-Stick-Pusher Working Group, as well as the Aviation Rulemaking Committee on Stick Pusher and Adverse Weather Training. Once vetted by industry at large, ICAO has indicated its intentions to adopt ICATEE's recommendations, eventually leading to a new Manual for Upset Prevention and Recovery Training. ICATEE plans to recommend enhancements to the simulator requirements in ICAO document 9625 when revised in 2012.

The opportunity to look forward is just beyond the horizon.

The author would like to thank his ICATEE colleagues for their valued contributions to this article.

## About the Author

Dr. Sunjoo Advani is chairman of ICATEE and a member of the Flight Simulation Group of the Royal Aeronautical Society. His own company, International Development of Technology, is based in Breda, The Netherlands. For more information on ICATEE, contact Dr. Advani at +31 655737345.

***Reprinted with kind permission of CAT Magazine Issue 3, 2011.***

# Frosty Front

by Imogen Cullen, Senior Safety Specialist

**Two Simultaneous In-flight Icing Events. On the 23rd November 2011, two early morning B737 flights, flying in opposite directions between Wellington (WLG) and Christchurch (CHC), both suffered aircraft damage after encountering in-flight icing at approximately the same time.**

## Occurrence 1: NZ 331 WLG-CHC in SJC

On climb out from WLG, the aircraft entered instrument meteorological conditions (IMC) at approximately 12000ft. The crew selected Engine Anti-Ice on and the climb continued to FL280 in moderate icing. The crew noted that the icing appeared to be less severe at cruise altitude than it had been during the climb. In the cruise north of CHC, off the east coast of the South Island in strong westerly conditions, the crew observed moderate rime ice accumulations in what they believed to be lenticular cloud formations.

Approximately 25mm of ice had accreted on the wiper bolt and approximately a quarter of the front heated windscreen was covered in white rime ice. However, the aircraft performance seemed normal to them (normal engine thrust output and pitch attitude) and the build-up on the wings was easily managed with wing anti-ice. To further manage the icing threat, the crew commenced descent early to allow for higher thrust settings which they hoped would reduce the likelihood of engine fan ice. During descent, the ice accretions increased markedly and changed to a more "wet", clear appearance.
The ice on the wiper bolt increased to approximately 50mm and at least half the front windscreen was covered in ice up to 6mm thick in places. The unheated portions of the cockpit windows became completely covered. The crew noticed the engine vibrations increased, however, they did not exceed 3 units. Nonetheless, the crew utilised the Quick Reference Handbook (QRH) "High Engine Vibration" procedure as an extra precaution. On finals the 'vibs' were between 2 and 3 units, as also indicated by later flight data recorder (FDR) analysis. After landing, reverse thrust use was limited to idle reverse as a precaution against damaging the engines should ice have been ingested. At the gate in CHC, the crew reported a large "dinner plate" sized piece of ice remaining on the radome. Engineers were summoned to check the airframe for possible ice impact damage. While the airframe was found to be unharmed, the engineers discovered significant damage to the engine fan blade tips of both engines (Figure 1). The FDR analysis showed that the indicated air temperature during the cruise portion of the fl ight averaged -7 degrees Celsius TAT (equivalent to an actual outside air temperature of -32 degrees) and the temperature during the descent between FL240 and FL180 as between -2 and 2 degrees (OAT between -22 and -15 degrees). Both fan blade sets were fully replaced and the aircraft was back in service just days later.

## Occurrence 2: NZ 332 CHC-WLG in NGG

Meanwhile, NGG was departing CHC as NZ332. This aircraft accumulated ice during the climb between FL180 and the planned cruise altitude of FL230 with an indicated air temperature of approx 3 degrees, as reported by the crew. Accordingly, aircraft anti-icing systems were utilised throughout the flight. The crew observed ice accumulating on the windshield and wiper bolt and assessed the ice to be moderate. They reported the icing to ATC, and obtained further clearance to climb to FL270 for the cruise in an attempt to climb above the icing layer. Once established in the cruise, the ice did not intensify and the aircraft performance during cruise and descent appeared normal to the crew, although they perceived a possible ice impact that they could not verify at the time. Aside from that observation, there were no

*Figure 1: Damage to the fan blades of both engines on SJC*


*Figure 2: Damage to the horizontal stabiliser on NGG*

indications of elevated engine vibrations or unusually large ice deposits on the surfaces visible to them. After arriving in WLG, damage to both sides of the horizontal stabiliser was discovered (Figure 2). This was presumed to have resulted from the large chunks of ice that had accumulated on the airframe hitting the stabiliser as it broke off the aircraft. Given the availability of environmental information from the download of SJC's flight data, the FDR was not downloaded for this flight. As with SJC, the cost of the repairs was substantial.

## The Weather Situation

These two icing encounters occurred whilst both aircraft were transiting an area of moist, strong north-westerly airflow associated with the passage of a warm front, as represented in the Mean Sea Level (MSL) analysis chart (Figure 3). These conditions caused significant mountain wave activity in the lee of the mountain ranges. The cloud top temperature chart (Figure 4) in particular demonstrates the strong gradient in the lee of the mountain ranges that gave rise to supercooled water droplets at altitude. This area around and along the east coast of the South Island, particularly north of CHC, is well known to domestic pilots as conducive airframe icing conditions.

## SIGMETs

The MSL analysis for November 23rd prompted the Metservice forecasters to issue warnings about anticipated severe icing in the area east of the Southern Alps, north of Christchurch, in the form of the following "signifi cant meteorological reports" SIGMETs which both crews had received in their planning documentation.

NZZC SIGMET 24
VALID 221604/222004 NZKLNZZC NEW ZEALAND FIR SEV ICE FCST ABT/E OF RANGES N OF NZCH AND S OF NZWB FL140/240 STNR NC=
(SIGMET valid on the 23rd from 05:04 to 09:04 NZDT - severe icing forecast about and east of the ranges north of Christchurch and south of Woodbourne at altitudes between FL140 and FL240, stationary, intensity no change).

NZZC SIGMET 32
VALID 221823/222223 NZKLNZZC NEW ZEALAND FIR SEV ICE FCST ABT/E OF RANGES N OF NZOU AND S OF NZWB FL140/240 STNR NC=
(SIGMET valid on the 23rd from 07:23 to 11:23 NZDT - severe icing forecast about and east of the ranges north of Oamaru and south of Woodbourne between altitudes FL 140 and 240, stationary, intensity no change).

Metservice meteorologist, Ross Marsden, explained that SIGMETs regarding "severe ice about and/or east of mountain ranges almost always refer to glaze icing in mountain waves, particularly on the updraft side immediately upwind of a crest. Very often this will be located east of the main divide of the mountain range. These areas must be treated with the utmost caution". He further commented, "There must have been A LOT [of ice] to have caused the damage you describe. Severe icing can build up very quickly to depths of several centimetres. If either aircraft had tracked a few miles further west, they would have been in clear air and had a spectacular view of the back of the wave which, from the temperature range between the trough to the crest, must have been 23000ft high!"

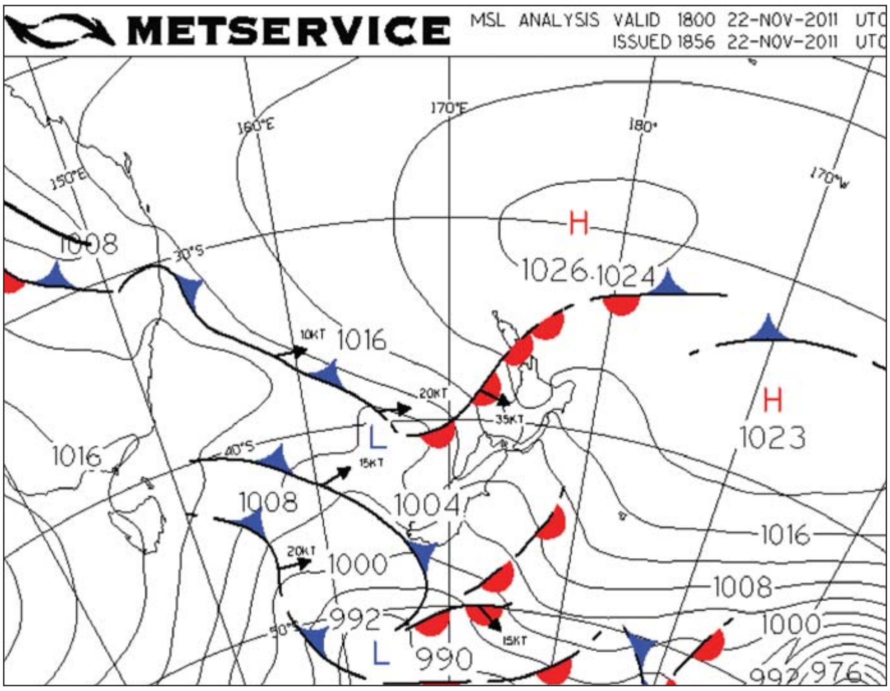



*Figure 3: The MSL analysis chart valid during the time of the two flights shows a warm front in a deep moist northwest air stream approaching central New Zealand*

It is important to note that both crews proactively managed the icing threat during flight and were surprised at the extent of the damage (in particular, the captain of SJC pointed out that the B737 FCOM suggests that engines will not be damaged even if the vibrations indicate full scale during ice shedding). Boeing icing procedures specify that engine anti-ice should be selected on whenever icing conditions exist or are anticipated, which is when indicated air temperature is below 10 degrees Celsius in visible moisture conditions, and to use wing anti ice when ice accumulations are observed on the aircraft. Both crews adhered to these guidelines and remained vigilant throughout the flight, altering the planned flight profile to minimise the icing risk to the aircraft, yet both aircraft were badly affected by the ice. This was particularly interesting as, while the icing conditions were certainly quite severe, they were by no means atypical. Frontal conditions often produce the ingredients necessary for severe icing in a band of lenticular cloud along the east coast of the South Island north of Christchurch, and damage to that extent has not previously been experienced by our aircraft transiting the area. For example, earlier in 2011, another B737 encountered icing on the WLG-CHC route. That aircraft experienced engine vibrations in excess of those experienced by SJC (over 4 units), necessitating the QRH High Engine Vibration procedure. Yet, despite the unusually high vibrations and an audible bang heard by the crew just before the engine vibrations rapidly increased, that aircraft did not sustain any damage.

Similarly, an Air New Zealand B737 flight from CHC to WLG in 2005 encountered severe icing conditions at FL230 with engine vibrations of up to 4.5 units. No damage to the airframe or the engines resulted but analysis from the Metservice was obtained. It stated that "the moist westerly flow, combined with extra moisture associated with the front across the South Island, led to the development of the wave cloud in the east. The presence of supercooled liquid water droplets to high altitudes east of the main mountains gave rise to the icing encounter. This is a well known trouble spot which happens to be on a main route. On this occasion several factors came together to make it particularly nasty. It also demonstrates how super-cooled liquid water can exist at very high altitudes and at correspondingly very low temperatures".

While it is not unusual for pilots to receive SIGMET reports regarding severe icing in this "known trouble spot" along the main trunk in their weather package, the fact remains that in spite of the above examples, numerous flights have transited this area without suffering ill-effects. It is therefore vital that we do not become desensitised to the warnings, even if it seems that actual conditions seldom live up to the warnings. In certain conditions involving particularly moist airflows and strong westerly winds aloft, icing can be particularly severe. In other words, warnings regarding severe icing could well mean exactly that!

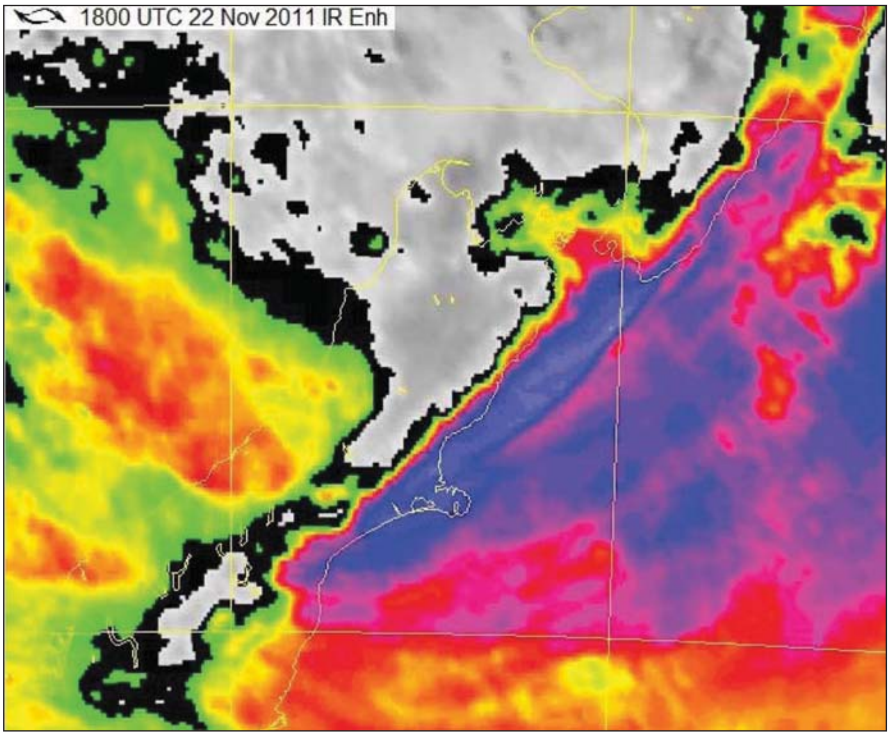



*Figure 4: From Metservice: "The satellite image superimposed with a colour scale for cloud top temperature (grey for warm through green to light blue for cold) shows a huge wave with a crest just east of the Kaikoura Coast. This means the rising side of the wave is more or less along the coast where the colour scale gradient is steepest. This is where vertical motion, condensation, and supercooled water production is highest. The freezing level was about FL100, so in the zone where the temperature is below about -10 or -15 C (down to about -25C), the water will be super-cooled and this is high risk for airframe icing".*

If one good thing came of these events, it is that the information we provided to the Metservice helped them correlate the actual conditions experienced with data from their new radar systems, which can distinguish between supercooled water and ice. This is important as it is the supercooled water droplets that pose the greatest threat. As the forecasters become more familiar with this new radar data, they will be able to provide more specific forecasting of severe ice regions than they are presently able to in SIGMETs.

Yet, why did we see such damage to two B737s on this one day when previous flights have remained unharmed? Following the November events and some initial analysis, Boeing were notified of the icing damage to the B737 aircraft in the hope that further light could be shed on exactly that question as well as a few others. For example, why have some in-flight encounters resulted in fan blade damage, despite relatively low engine vibration values, whereas in other events, high engine vibrations caused by ice have caused no harm? If engine vibrations are not an accurate indication, how can crews gauge in-flight whether in-flight icing is damaging the engines given that definitions of icing severity vary between states but share the common problem of subjectivity? What additional measures can we employ to reduce this risk?

Firstly, Boeing responded that reports of damage due to ice ingestion are rare but they do occur. Regarding the FCOM advice that high vibrations will not cause engine damage, Boeing clarified that during the fan ice removal procedure, engine vibrations may be high due to uneven shedding of the ice, but it is not expected to damage the engine because it is typically of short duration. Fan vibration can become elevated during ice removal when there is uneven shedding of ice

## Supercooled Water Droplets

For a number of complex reasons, water exists in liquid form well below 0°C. Supercooled water exists because it lacks the ability to complete the nucleation process. Two of the factors influencing the freezing of supercooled droplets are the need for a freezing nuclei (usually ice crystals) and latent heat which is released when water freezes.

In "cold" clouds, where the temperature is below 0°C, ice crystals and supercooled droplets co-exist. In these 'mixed' clouds, the air is close to being saturated with respect to liquid water, but is super-saturated (an unstable phase) with respect to ice. Consequently, in mixed clouds, ice crystals grow from the vapour phase much more rapidly than do the nearby droplets. This is usually known as the Bergeron - Findeisen process.

- At temperatures between 0°C and -15°C most clouds are composed of supercooled water droplets.
- Between -15°C and -40°C most clouds contain a mixture of ice crystals and supercooled water droplets.
- Below -40°C almost all clouds consist entirely of ice crystals.

Supercooled droplets are in an unstable state and usually start to freeze when brought into contact with ice crystals and particles with a similar structure to an ice particle (freezing nucleus). The ice crystals may form directly from water vapour in the cloud or fall into the cloud from above.

When freezing of supercooled droplets takes place spontaneously, the larger water droplets tend to freeze more readily than smaller droplets. The freezing of droplets becomes more probable as the temperature decreases.

The latent heat released in the freezing process serves to warm the air immediately surrounding the droplet relative to the air surrounding the cloud, thereby promoting instability and upward development of the cloud.

A term often used in discussions regarding in-flight icing is "Supercooled Large Droplets". If an SLD is large enough, its mass will prevent the pressure wave traveling ahead of an airfoil from deflecting it. When this occurs, the droplet will impinge further aft than a typical cloud-sized droplet, possibly beyond the protected area, and form clear ice.

### Definition

"Supercooled Large Drop (SLD). A supercooled droplet with a diameter greater than 50 micrometers (0.05 mm). SLD conditions include freezing drizzle drops and freezing raindrops. 2 - FAA AC 91-74A, Pilot's Guide to Flight in Icing Conditions.

http://www.skybrary.aero/index.php/Supercooled_Water_Droplets

from the fan. Ice originating from the spinner does not produce high vibration, since it's near the centre of rotation. The potential for damage is a function of ice size and the engine RPM at which it sheds. The following advice was issued by Boeing, "When in doubt, the fan ice removal Supplemental Procedure should be performed when the engine vibration does not exceed 4.0 units. When high engine vibration indications are present (more than 4.0 units), the Non-Normal Checklist should be done."

In terms of how pilots might judge icing severity in order to make informed decisions, Boeing confirmed our understanding that in the absence of specific definitions and criteria for icing severity, "Boeing procedure is to follow the guidance in the FCOM Supplementary Procedures for Adverse Weather (SP 16) in an effort to prevent aircraft damage due to icing; namely, to use engine anti-ice any time icing conditions exist or are anticipated (10 deg C or less with visible moisture, except when temp is below -40 deg C during climb or cruise), and to use wing anti-ice any time ice accumulation is present on the aircraft surfaces visible from the flight deck, and/or flight deck window frames, windshield center post, or on the windshield wiper arm. The Flight Crew Training Manual states the safest course of action is to avoid prolonged operation in moderate to severe icing."

### Conclusion

The information provided from Boeing and the Metservice, in conjunction with the analysis of the flight data from the SJC flight, enabled the following conclusions to be drawn:

- The warnings of severe icing provided in SIGMET were valid and both aircraft experienced genuine severe icing in-flight.

- The fan blades of SJC were most likely damaged by the impact of ice shedding from the spinner and possibly other parts of the fan.

- The horizontal stabiliser of NGG was more likely to have been damaged by ice shedding from the airframe than the engine fans.

- The route between WLG and CHC is especially vulnerable to severe icing when a moist, westerly airflow is present, particularly in lenticular cloud formations extending to high altitudes.

*Figure 5: Extensive ice on a heated windscreen is a likely indication of severe icing, according to the website: http://www.b737.org.uk/iceandrain.htm*

So, it can be difficult for pilots to accurately assess the real risk posed by inflight icing and know when to take steps to exit those conditions. Clearly, it is not practical to suggest that all icing conditions be avoided, as forecast icing areas can be extensive. As stated in our own policy contained in SOP (Boeing) 3.8.1:"*If enroute icing reported or forecast, operation is permitted provided the PIC considers that the altitude and severity of icing will not adversely affect the safety of the flight. If icing over the planned route is extensive, the PIC must plan alternative route or use a pre-planned deviation.*"

In light of the damage sustained by SJC and NGG, and the global lack of clear criteria for assessing in-flight icing severity, it pays to tread carefully in icing conditions: consider additional contingency fuel to allow for both lateral and vertical deviations during flight and be prepared to alter your flight path if ice continues to build on visible surfaces despite the use of anti-icing and de-icing equipment.

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