# focus

ON COMMERCIAL AVIATION SAFETY

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*Front Cover Picture: Heathrow Control Tower - 2005*
*Picture courtesy of Flight Images*

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# Human Error In Aviation

The aviation accident statistics since the 1950s show there has been a marked reduction in the accident rate worldwide. Most of the improvement has been achieved by technological advances in the industry. The reliability of materials used in manufacture of the aircraft and its many components are much improved.

Aircraft in service reliability increased when manufacturers moved from piston powered to turboprop engines. This was improved yet again when turboprops were replaced with jet and bypass engines.

Back in the 1950s and 1960s incidents seemed to be mainly of a technical nature and the high number of these most probably masked those incidents caused inadvertently by either pilots or engineers. More recently we noticed that there is an increasing acceptance that most accidents have a human error or human factors component.

We have seen the aircraft manufacturers attempt to improve the man-machine interface of their products in an attempt to design out as many human factors issues as possible. Some manufacturers employ human factors experts in their organisations in order to try to consider every aspect of a design change that could lead to human error. The development of the common cockpit across fleets puts a commercial emphasis to this.

In spite of this, human factors errors continue to occur more frequently than we would like them to.

Commercial "gurus" in the aviation industry tell us that the way to make money in an airline is to keep the aircraft in the air for as many hours as possible each day and to cut costs to a minimum. Theoretically, this is correct. There are however other factors that need to be considered before we can say categorically that this is achievable.

In many airlines the crew rostering departments are instructed to "squeeze" as many flying hours out of the operators' pilots as possible, in an attempt to improve pilot utilisation. Were it not for national regulations would there be a limit to this? This is after all an expensive resource and needs to be maximised.

Over a period of years training time has been pared to the absolute minimum in order to save money. There seems little point in training for circumstances that the crew might never encounter. After all aircraft reliability has never been better. Who determines what the crew may never encounter?

Aircraft maintenance staff now work harder and longer than ever, in an attempt to keep the aircraft serviceable. When engineering staff retire or resign operators find it increasingly more difficult to replace them with suitably qualified and experienced people.

Many airline apprenticeship schemes have been discontinued in order to save money. Apprentice training is not the airlines' core business. So where do airline technicians gain their relevant education and training and is it really surprising that there is a shortage of well trained and experienced aviation maintenance staff?

Nobody wants to do shift-work, during unsociable hours in the cold and wet, covered in fuel and oil, for the salaries offered in aviation maintenance organisations today. Young people would far rather find a job in a warm dry office, with regular hours, with time to have fun and a better prospect for advancement.

Wherever we have man controlling anything, be it train, motor vehicle, ship or horse drawn carriage we will find human error responsible for a percentage of the accidents or incidents.

We have tried through technological improvement to reduce the number of accidents to zero. We have achieved a great deal but we have not achieved our goal.

What we have not tried is to improve the competence of man through increasing the amount of training. There is little doubt that the better skilled and knowledgeable man is, the better he is able to cope with unusual situations if and when they arise. This additional or recurrent training may cost more money in the short term but could save many times the cost in the longer term. If we are going to reduce the amount of human error we will have to increase the amount of recurrent training that aircrew and maintenance personnel undergo.
The commercial "gurus" will say we cannot afford this increase in our training budgets in order to have better skilled pilots and maintenance engineers. Many may argue in favour of reducing them further. Others would argue that we need to increase our recurrent training cost in order to reduce the cost of incidents and accidents caused by human error.

It would seem that there is a need to strike a balance between the amount of training provided and what is considered to be an acceptable risk. Who will decide the definition of acceptable risk?

## Chairman's Column

The last twelve months has seen yet more economies in the aviation industry as operators in all sectors attempt to cut their costs to a minimum. I am pleased to say that, although members have undoubtedly been affected by these economies, the membership of the UKFSC has not been affected, indeed it has grown. It is still seen by the industry as a worthwhile group contributing to our collective safety.

I believe that one of our biggest contributions to this safety is the Safety Information Exchange. We are able to gather every few months and discuss our own and mutual problems. The unique aspect of these discussions is the presence of the Regulators in the same room, and the willingness of all the Members to speak about anything, even if it might reflect on their own systems of work.

The same approach can also be used by Operators, whether they are involved with aircrew, engineers, ATC or any of the many Service Providers in Aviation. The regular safety meetings should reflect the same culture that the company is trying to engender in their employees. The fact that Senior Management is attending the same meeting should not impede discussions of any nature that are considered to be of significant safety interest. It is, understandably, sometimes difficult for more junior members to assert their ideas when faced with a sea of 'management' faces. This is where the tact and diplomacy skills come to the fore in order to get your message across! Open reporting cultures can only do good if they are not only used, but seen to get responses.

There has been much going on in the industry with security-related issues and this has inevitably had some impact on Flight Safety. I have maintained over the year that, whilst we must be conscious of security implications on our sector of the industry, as a Committee of Safety Professionals, we must be careful not to be drawn into areas that are already well served by experts in their field. I still believe that this is the right approach; after all, we have access to probably the best information in the industry and are able to find out any security issues that give us concern. We will, however, still continue to monitor any changes to security that have a direct effect on Flight Safety.

This has been a year of change in the industry and, after a few dark times, perhaps there is now a brighter horizon in view. I believe that the work that we do on the UK Flight Safety Committee only serves to enhance our position in the industry and we should continue to flourish as an important part of the improving safety culture that is happening throughout the industry. Let's keep spreading the word.

by Stuart McKie-Smith

### 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.

## Air Carrier Liability: EPA study reveals water contamination in one aircraft in seven.

I am grateful to my colleague, Peter Coles, a solicitor specializing in aerospace in Barlow Lyde & Gilbert's Hong Kong office, for the following article (which appeared in issue 20 of BLG Aerospace News) regarding a study carried out by the United States Environmental Protection Agency into the state of drinking water safety on airlines which may be of interest to FOCUS readers.

A recent study by the U.S. Environmental Protection Agency ("EPA") has revealed that one in seven aircraft tested had unwanted stowaways in their water supply -- potentially dangerous bacteria that can make passengers and crew sick: we examine the legal implications.

In the United States, drinking water safety on airlines is jointly regulated by the EPA, Food and Drug Administration (FDA), and Federal Aviation Administration (FAA). The EPA regulates the parent systems that supply water to the airports and the drinking water once it is on board the aircraft in accordance with the Safe Drinking Water Act (SDWA). The regulatory structure for all public water systems, including aircraft, relies upon self-monitoring and reporting of results to the EPA. The FDA has jurisdiction over culinary water (e.g. ice) and the points where aircraft obtain water (e.g. pipes or tankers) at the airport. The FAA requires airline companies to submit operation and maintenance plans for all parts of the aircraft, including the potable water system.

In the summer and autumn of 2004, the EPA tested drinking water aboard hundreds of randomly selected domestic and international passenger aircraft. The first and second rounds of testing showed total coliform and e.coli in, respectively, 13% and 17% of samples. Total coliform are indicators that other disease-causing organisms (pathogens) could be in the water and could potentially affect people's health. Total coliform and e.coli cause intestinal distress, stomach cramps and nausea (symptoms that can look very similar to the flu or food poisoning) and are often associated with human faeces.

On 9 November 2004, the EPA announced commitments from 12 major U.S. passenger airlines to implement new aircraft water testing and disinfection protocols as well as a proposal to draft new regulations over the next 12-18 months. Under the commitments, airlines will implement quarterly disinfection of water delivery systems aboard passenger aircraft. They will also increase monitoring and they face strengthened public notification requirements when testing reveals water that does not meet EPA standards. Airlines will also be required to analyze possible sources of contamination that exist outside of the aircraft and to provide information related to practices of boarding water from foreign public water supplies not regulated by EPA.

### Liability of Airlines

Under Article 14 of the Chicago Convention 1944 each contracting State is required to take effective measures to prevent the spread of communicable diseases and to keep in close consultation with those international agencies concerned with international regulations relating to sanitary measures applicable to aircraft. States must issue guidelines for airlines, by liaising with bodies such as the WHO.

In considering the liability of airlines to passengers that have contracted illnesses from contaminated water supplies, a distinction needs to be drawn between claims brought in countries that recognise the applicability of the Warsaw Regime and Montreal Convention (as well as, in many cases, the exclusivity of the cause of action thereby provided) and those countries that do not, such as Thailand and Taiwan where domestic tort and contract law principles regarding person injuries/death will apply.

The Conventions require an accident to have caused the illness and to have taken place on board the aircraft or in the course of operations of embarking and disembarking. The US Supreme decision in Air France-v-Saks gives the authoritative definition of the term "accident" as "an unexpected or unusual event or happening that is external to the passenger", also holding that an injury resulting from "the passenger's own internal reaction to the usual, normal and expected operation of the aircraft", is not caused by an accident.

In the Scottish decision of King-v-Bristow Helicopters, the House of Lords held that compensable "bodily injury" includes "the physical infliction of physical injury during the flight even though not already manifested at the conclusion of the flight, for example a disease or illness contracted upon the aircraft say through the contamination of …on-flight food". In the American case of Re Alleged Food Poisoning Incident, March 1984, Abdulrahman Al-Zamil-v-British Airways the court held that the supply of infected food to passengers causing food poisoning was an accident within the meaning of Article 17. The same would obviously apply were the offending substance drink rather than food, and this was held to be the case in the American case of Scala-v-American Airlines when an alcoholic drink was given in error, the passenger having asked for a non-alcoholic drink because of his heart

condition. However, a person being "nauseated by standard airline fare" was held not to be an accident in the American case of Fishman-v-Delta Airlines.

The burden of proof will be on the passenger to prove that he/she suffered an illness as a result of the consumption of contaminated water supplies on the aircraft. Since the physical manifestations of food or water poisoning/contamination do not always arise during a flight, it can be difficult for passengers to prove that an accident within the definition of Article 17 has occurred. Often, the longer they leave a potential claim the harder it is to provide such evidence. In each case where a complaint is received, an airline will need to investigate the entire process by which water is supplied and, where an accident is determined to have taken place, take recourse action against those parties responsible for the contamination, who may include airline caterers, toilet cleaners and fresh water suppliers.

In press releases the EPA has advised passengers with compromised immune systems such as the elderly, cancer patients, pregnant women and young children or others concerned to request canned or bottled beverages and avoid drinking coffee, tea, and other drinks. That is probably sound advice although the EPA has yet to identify any cases of outbreaks of illnesses from contaminated water on aircraft.

Vanessa Leigh, solicitor Barlow Lyde & Gilbert

## The BALPA Peer Intervention Seminar 28th June 2005 – The Royal Aeronautical Society

The UK Government introduced in 2004 the Railways and Transport Safety Act, so putting in place a procedure for identifying Aircraft Crew, Engineers and Air Traffic Controllers who report for duty when unfit due to alcohol or drugs. Drug and alcohol testing policies in the airline industry have been reviewed following two high profile events and although the Act does not embrace random testing, a number of airlines have indicated that they support such a policy. Despite its perceived benefits, random testing will not detect real problems of drug or problematic alcohol use. The policy will not detect those people who suffer most from problems of alcoholism, but it will engender a punitive approach, where rehabilitation as an aim will be downplayed in favour of disciplinary action. This in turn will deter people from coming forward with problems and others from identifying colleagues with a problem. We believe that anyone who takes drugs or alcohol in proximity to duty has a drug/alcohol problem. (Our aim is to ensure identification at an early stage).

We believe that the best solution is peer intervention, where critical support, treatment and rehabilitation take preference over punishment, and BALPA has modelled this programme on the highly successful US Human Intervention and Motivation System (HIMS) Programme, where individuals and their colleagues have no fear of coming forward and identifying alcohol and drug problems. HIMS has been government funded and approved since 1974. The US introduced random testing for safety critical transport staff in 1991 in response to some high profile incidents under random testing only a small number of flight crew have ever been detected. Contrasted with HIMS, which has rehabilitated in excess of 1500 pilots in the US airline industry, and has the practical, financial and moral support of all stakeholders, we are convinced that this “Peer Pressure” approach and not random testing is the way forward.

The policy should generally:

- Be a coherent national policy to which all air transport operators subscribe, and which has the support and involvement of unions and employees.
- Should be based upon peer intervention policies, with testing for pre-employment, post accident and on reasonable suspicion.
- Should be used as the basis for an international policy, providing for a global drug and alcohol policy for the industry.
- Encompass all staff.
- Encourage a rehabilitation approach to addiction problems.

The BALPA Peer Intervention Programme aims to address these points as part of an agreed non-punitive scheme between BALPA and the airline employers operating within the airline in a similar manner to the FDM programme.

At the seminar we aim to discuss alcoholism and addiction, the US HIMS policy and what has made it so successful and outline the BALPA /Airline method in working together to develop an accepted programme in each airline.

We have invited the current Parliamentary UnderSecretary at the Department for Transport to open the seminar. Speakers will include Dr Donald Hudson of US-ALPA, Dr Sandy Mitchell, Chairman of the BALPA Medical Group and Dr Paul Collins of the UK CAA.

The seminar will be funded by BALPA with a contribution by the DfT. Attendance will be by invitation. If you would like an invitation on behalf of your airline please contact the BALPA Flight Safety Department, flightsafety@balpa.org.

# (Almost) Everything you Wanted to Know about RAS and RIS but were afraid to ask - A Pilot's Guide

## Availability

Radar Advisory Service (RAS) and Radar Information Service (RIS) are only available outside controlled airspace.

This is not the same as saying that RAS and RIS are available everywhere outside controlled airspace.

Availability depends upon radar coverage and upon the ATC provider being open and having the capacity to provide the service.

At some civil units, controllers provide RAS and RIS as an extra, on top of their primary responsibility for controlled airspace. However, if they get too busy with the latter, they may have to discontinue or change their RAS/RIS provision.

Most military airfields shut over weekends and Bank Holidays. Although this reduces the likelihood of bumping into warplanes, it also means fewer radar units available to provide you with RAS or RIS.

You have hereby identified a significant defect in the UK air traffic system in that radar coverage is not universal and your air traffic service of choice is not always available. However, to remedy this would cost megabucks.

Equally galling - because everyone tends to ask for a RAS in bad weather - solid IMC could be the very time when the controller tells you he is too busy with other traffic to provide you with the radar service you want and need. Joseph Heller called this Catch-22!

## Application

RAS will only be provided to flights under IFR. IFR is not the same as IMC and, outside CAS, relates only to the Minimum Height Rule and the Quadrantal Rule. Any pilot can elect to comply with these rules.

However, if you are not qualified to fly in IMC, you should only take an RAS if compliance with ATC advice enables you to remain VMC.

Under a RAS:

- Although the controller may pass you information in the form of an instruction, it is only advisory; if you choose not to follow his advice, you become responsible for any subsequent avoiding action. But please let the controller know.
- A controller will aim to provide you with safe separation against other traffic in receipt of a RAS. Life gets more difficult if the other traffic is unknown because he cannot be sure of its intentions; he will try to obtain minimum separation of 5nm or 3000ft (using Mode C) but circumstances might make this impossible.
- If time permits, the controller will call traffic and suggest action to resolve the confliction. However, if the other traffic is unknown and appears suddenly, he will normally reverse this sequence and pass advisory avoiding action first, followed by information on the traffic.
- If the first words you hear are your callsign followed by 'Avoiding action', you would be well-advised to follow the controller's advice without delay. The threat is immediate!

Under a RIS:

- The controller will tell you about conflicting traffic. It is then entirely up to you what you do with the information. The controller will not offer any avoiding action.
- You remain wholly responsible for maintaining separation from other aircraft whether or not the controller has passed traffic information.
- You must ask if you want the controller to update you on a confliction. Otherwise, he will assume you have seen it. Alternative last sentence for consideration: "Otherwise, he will assume you are happy with the

*Picture courtesy Augusta Westland*

situation" because the pilot may not actually be visual with the conflicting traffic but not concerned about it due to good VMC etc.

- Although a controller may provide you with radar vectors, these will not be for the purpose of achieving or maintaining separation.

If you are receiving a RIS and decide that what you really want is a RAS, ask for it. The controller will often accept such a request if his workload permits, and will tell you that you are now under a RAS.

Under both RAS and RIS, please advise the controller before you change heading or level, unless he is already aware that you are manoeuvring. He cannot help you if you do not help him.

Under both RAS and RIS you remain responsible for terrain clearance.

## Caveats

If you want a RAS or a RIS, you must request it. You will not receive any kind of a service until the controller actually confirms what he is about to provide. In effect, what you are establishing with the controller is a 'contract'.

The act of identification does not imply provision of a radar service.

Under a RAS or RIS, ultimate responsibility for collision-avoidance remains with you because Class F and Class G airspace is not a known traffic environment and because the controller is only allowed to pass advisory information. This is not a cop-out.

The controller may not be able to provide you with a full RAS or RIS for various reasons, perhaps due to workload or maybe because there are too many other aircraft in your vicinity. He will then limit the service. Once again, this is not a cop-out by the controller. Rather, he is simply being honest with you so that you can take due regard, including increasing your lookout.

IF YOU INCLUDE CONSIDERATION OF ALL THE ABOVE IN YOUR FLIGHT PLANNING, AS WITH EVERYTHING ELSE, YOU ARE LESS LIKELY TO BE CAUGHT UNAWARES.

*Reprinted from FOCUS Issue 41 with revisions*

## What is a Flight Data Monitoring Programme?

*by David Wright, Senior FDR Analyst with the UK Civil Aviation Authority's Safety Regulation Group.*

Flight Data Monitoring is the systematic, pro-active and non-punitive use of digital flight data from routine operations to improve aviation safety. This information (and more besides) has the potential to become part of one of the most promising safety enhancement tools in an operator's inventory. By carefully analysing the data from every flight it can be used to improve day to day operating standards and techniques and the rare likelihood of actually needing an accident recorder becomes even rarer.

### Today's Requirements for Flight Data Monitoring

This systematic use of the information is known in the UK and Europe as Flight Data Monitoring (FDM), in the USA as Flight Operational Quality Assurance (FOQA) and by ICAO as Flight Data Analysis (FDA). These are all intrinsically the same process. ICAO have made it a standard for all Public Transport operations of aircraft over 27 tonnes MTOW with effect 1st January 2005 and have, since 2002, recommended FDM for all Public Transport operations of aircraft of over 20 tonnes MTOW.

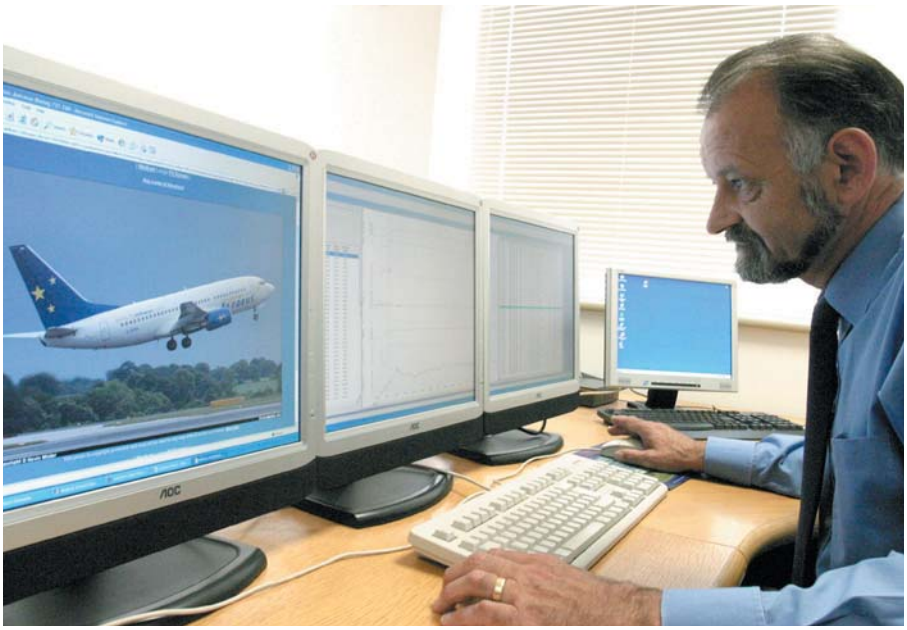
The UK, in continuing its policy of applying ICAO standards, have amended the Air Navigation Order 2000 so that Article 34A now requires the establishment and maintenance of an Accident Prevention and Flight Safety Programme and including the requirement for FDM. Similarly the JAA have also adopted this into JAR-OPS-1.037. These requirements emphasize that FDM is not just a tick in a box; it is not just a box on the aircraft and certainly not just data in a filing box – but a systematic method of using line flying experience to actively improve safety.

### Advisory Material

In the UK Operators have been quick to see the safety benefits of FDM and more than 75 percent of UK operations were already covered by some kind of FDM programme even before the introduction of the Requirements. However, with the formal Requirements came a need to "regularise" or better define the processes surrounding such programmes.

The UK CAA have produced advice for Operators and other interested parties in Civil Aviation Publication CAP739 " Flight Data Monitoring – A Guide to Good Practice". This document aims to give practical advice based on many years of UK experience and outlines a set of guiding principles which have formed the basis of the JAR ACJ- OPS 1.037(a)(4) advisory material. These are not prescriptive system definitions because there is no "one-size-fits-all" FDM system that can be applied to all operators ranging from a 200 aircraft fleet to a 2 aircraft fleet, and from a modern Boeing or Airbus (with hundreds of parameters available) to an older Boeing or turboprop (with limited parameters and recording devices). The intent is to help Operators understand the underlying components of systematic FDM so they can maximise the safety benefits available from their particular circumstances.

The next edition of ICAO's Accident Prevention Manual (Doc 9422) will also include a new section on FDM to bring this useful publication up to date.



*"Properly validated data can enable an operator to identify previously unknown risks" Picture courtesy of Flight Data Services Ltd.*

### Important Aspects of the Introduction of FDM

### The Safety Culture

The state of the safety culture within an organisation is critical in determining the success or failure of their risk management processes, including FDM. There has to be a recognition and practice at all levels of a "just reporting culture" that fosters the exchange of lessons learnt and individual experiences

to the benefit overall safety levels. This can be felt in an organisation where crews feel free to communicate their issues, lapses and errors with the flight safety department and where managers recognise the need to use these minor deviations as a building block towards improved overall standards, thus reducing the total risk of operations. It should be noted that both Unions and Management in the UK have recognised that there is a limit to the protection given to crews. Both parties have a duty to take action in the circumstances of an on-going safety hazard or after finding "gross negligence or criminal acts".

The role of the safety professional is a difficult one and the Flight Safety Officer or FDM manager walks a narrow path between management and the staff. They have to maintain the trust of the staff to ensure open communications while having the stature and integrity to be taken account of by staff and management alike. The advisory material indicates the responsibilities for discovery and action may be spilt between departments and it can be in this split that difficulties arise. This is where a defined process of alert/challenge leading to reply/rectification is needed to ensure that action is taken where appropriate. Reporting of issues to a high management level can be effective in guaranteeing this.

Part of the Safety Culture is the establishment of trust and understanding throughout the organisation. This can be "kick started" by ensuring that staff and management all buy into and own the programme. A document that outlines the principles, processes and controls formalises this and a list of contents are specified in JAR ACJ-OPS 1.037 (a) (4) item 12.

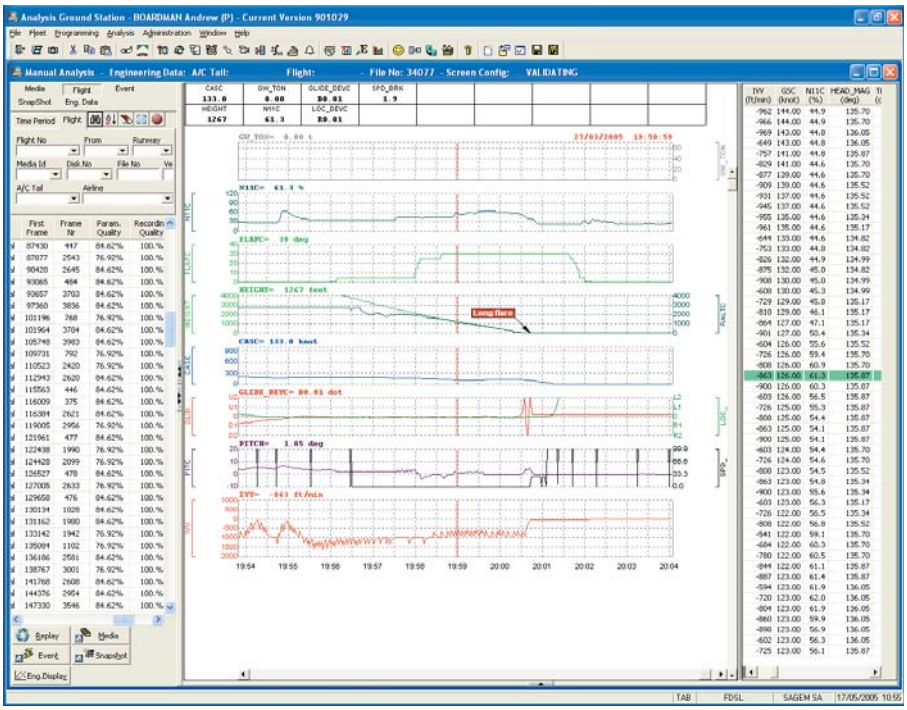
## Resources

All Operators today are working towards improving efficiency in all areas – including safety! When resources are withheld in the area of safety monitoring and improvement this can become a liability to all concerned. The mechanics of data collection become the focus – often to fulfil a mandatory requirement – and sight is lost of the real objective – to learn, act upon and improve safety. The computer system relentlessly produces data, which, if not properly acted upon, will become a millstone after an incident that could have been prevented by proper process.

Very few operators new to FDM realise the scale of resources necessary to implementation and exploitation. They have heard of all the benefits but are often not made aware of the "paddling that goes on beneath the surface" in a successful programme. In a recent example, an airline had scheduled two man days a month" during the implementation of a new programme, which is totally unrealistic. The system will inevitably need de-bugging and fine tuning to suit the operator's SOPs. There will be many lessons learnt and risk assessments to be made during those first few months. Some of these will need hard decisions to be made about whether a previously unknown risk is acceptable or not. Assuming the data has been properly validated this indicates that the FDM programme is working well. It does not mean "just too much data" and a reason for changing all the event limits!

## Airworthiness Issues

Operators must put in place procedures to cover the exceedence of any airworthiness limits identified in the data, such as for a heavy landing, that would require a subsequent action. Such limitations are normally given by the manufacturer in approved flight and maintenance manuals. The procedures should differentiate between "hard limits"




*Picture courtesy of Flight Data Services Ltd.*

such as in the heavy landing case, where action must be taken, and those where some degree of discretion may be exercised – for example in Birdstrike Vmo Exceedences. In the latter case there is an increased potential for damage and in the former there may be actual damage. If an airworthiness issue is discovered, by whatever means, then it must be recorded in the aircraft maintenance records and addressed appropriately before the aircraft is released back to service. Faults will either be rectified or deferred if permitted in accordance with the MEL. Procedures already exist, for example in JAR OPS 1.915 and its' associated AMC, which cover the case where an airworthiness issue is discovered in-service, possibly with an aircraft away from base, and ensure a decision is made by the appropriate LAE, as to how and when the defect is to be rectified.

UK experience has shown that, in established FDM programmes, only on very rare occasions will there be a FDM discovered deficiency where there is no pre-existing report by flight crews or other personnel. In new programmes confidential and constructive feedback to crews are expected to improve reporting standards. This may result in a step change in the number of reports – in knowledge of an issue but not its' actual frequency.

## Safety Professional Skills

The role of the safety professional is a difficult one and the Flight Safety Officer or FDM manager walks a narrow path between management and the staff. They have to maintain the trust of the staff to ensure open communications while having the stature and integrity to be taken account of by staff and management alike. The advisory material indicates the responsibilities for discovery and action may be spilt between departments and it can be in this split that difficulties arise. This is where a defined process of alert/challenge leading to reply/rectification is needed to ensure that action is taken where appropriate. Reporting of issues to a high management level can be effective in guaranteeing this.

## FDM Skills and Training

There are various skills required in a FDM system which is data driven, numeric, analytical and open to interpretation. Among these are:- computing technology, aircraft systems, operational experience, analytical techniques, investigation techniques, education and training, management. In a large operator this mix may be achieved by several staff working as a team whereas in a small concern one individual may have to "wear many hats". It is possible to contract out some of the technical work and analysis to a specialist company but the operator must still retain sufficient skills and resources to take responsibility for the entire FDM system.

*"Very few operators to FDM realise the scale of resources necessary for implementation & exploitation."*
*Picture courtesy of Flight Data Services Ltd.*

There are a number opportunities for FDM training:- Aircraft manufacturers, Airbus in particular, run FDM courses on their aircraft; FDM system suppliers run specialist courses on their products; companies specialising in outsourcing solutions to FDM offer consultancy; and Cranfield University in association with the CAA offer a "FDM for Airlines" shortcourse.

## Conclusions

A well oiled and constructed FDM system represents a major step forward in the monitoring and reduction of aviation safety risks. Its implementation is reliant more on the "soft" issues of resources, staff management interaction and willingness to learn/change rather than the specification of a computer program. With the coming of formal Requirements these issues must be addressed in a professional way and integrated with other safety information within a comprehensive Safety(or Risk) Management System. Given this professional approach, both the Operator and the Regulator can better understand the operational environment in all its facets and appreciate that:-
*"Just as there are sirens on the sea, so there are will o'the wisps in the air ready to lure the unwary to their doom."*

## There are Trainers at the Bottom of Our Cowlings!

*by David C. Johnson, Deputy Director (Engineering)- CHIRP*

*Picture courtesy BMED*

A recent report to CHIRP has revealed a hitherto unsuspected problem with catches/latches on aircraft cowlings being unsecured. We have all experienced, or read about, panels and cowlings becoming detached from aircraft either as they take-off or shortly into the flight.

Indeed the most recent AAIB Bulletin, 3/2005, reports on a panel 4 x 6 feet and weighing 70 lb (1.2m x 1.8m & 32kg in new money) that became detached shortly after take-off from Gatwick. Part of the door landed in a wooded area near Reigate having missed a couple by only some 20 feet. (The AAIB report as usual, is very detailed on the subject, but discretely describes the couple as 'out walking' at the time)! This panel had 13 catches and had been the subject of sign-off after a maintenance input and no less than seven walk-round inspections. Nevertheless the report concluded that it was most probable that all but one of the catches had been left undone. The report illustrates how difficult it is to determine if this type of catch is properly latched, from a relatively short distance.

So much for the familiar pattern of panels inadvertently left unlatched.

The CHIRP report gives a new slant, however. An Engineer departing a B737 (the type is relevant), having completed and signed for the pre-departure and walk-round checks, was in conversation with the Captain at the bottom of the aircraft stairs when he noticed a handling agent employee go to the number one engine and open the latch securing the lower engine fan cowl. The Engineer asked the Captain if he had any knowledge of what the person was up to and received a negative reply. The person was called over and asked what he was doing. The reply was, "I am a trainer (with the handling agency) and am trying to test my men". The objective, apparently, was to train ground handling personnel departing an aircraft to observe any unsecured latches, panels etc.

There are several points arising from this event. First and most obvious, it is illegal for an unqualified person to interfere with an aircraft in this way; if another unqualified person had observed the unsecured latch would they have reported it or re-latched it? If the latter, would this be legal? The latches on fan engines are notorious for appearing to be locked when in fact they haven't engaged; the B737 cowl latches are very close to the ground and not all that easy to secure. What if the 'trainer' had been called away from the scene before completing the 'training exercise'? Other 'what ifs' may be conjured-up!

The Engineer duly ensured the cowl was properly secured and re-signed for the pre-departure check: the Captain filed an ASR. It is understood that the Operator has since taken the problem up with the handling agent.

So, are all those reports of panels detaching from aircraft in flight due to Engineers, and others, having failed to secure them before flight and walk-round inspections, failed to find them?

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**Vice-Chairman**
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# Runway Safety

*Information Bulletin - Spring 2005*

A runway incursion is any occurrence at an airport involving the unauthorised or unplanned presence of an aircraft, vehicle or person on the protected area of a surface designated for aircraft take-off and landing.

## Background

During the 1990s the CAA identified a worrying number of incidents in which aircraft and vehicles were entering runways without authorisation. Work commenced to determine the causes of these events and to take measures to manage the risk of such incidents. During the year 2000 it became evident to the international aviation industry that runway incursions not only present a significant risk to the safety of civil aviation operations but that the incidence of runway incursion incidents appeared to be increasing. It was not clear whether the noted increase was a result of increased reporting, a greater awareness of the risks and the need for reporting or a real increase in the number of incidents. Nonetheless, there was a clear need for action and within the European region, EUROCONTROL, with substantial input from the UK CAA, co-ordinated a regional action plan.

## Action Programmes

At the time that EUROCONTROL was first considering the issue, the CAA established a Runway Incursion Steering Group (RISG) for the UK which has taken a number of actions to assist aerodrome operators to reduce the risk of runway incursions. Among the action programmes that are in progress are:

- a review of the safety data gathering system to identify causal factors and trends;
- a review of air traffic services (ATS) and airline operator procedures;
- a review of available and future runway protection technology;
- a review of the training and education of airside vehicle drivers;
- a review of airfield markings including signage and lighting;
- promotion of the inclusion of the runway incursion issue in Safety Management Systems used at aerodromes; and
- a UK runway incursion risk awareness campaign.

Some of these actions are internal to the CAA, although the output of each of the programmes will feed into the risk awareness campaign and other routine CAA processes such as development of new or modified safety regulatory requirements.

Since June 2001 all inspections at aerodromes conducted by the CAA, through the ATS Standards Department or the Aerodrome Standards Department, have included an audit topic on local runway incursion issues. When necessary, this has resulted in the development of recommendations, suggestions and a detailed amelioration strategy appropriate to each aerodrome.

*Aircraft wreckage following the accident at Milan Linate Airport*

## Purpose of this Bulletin

Not all of the effects of the action programmes are immediately apparent. This brief provides information on CAA activity and provides a reference to resources that are available to aerodrome and aircraft operators to assist them in managing runway incursion risks.

## Data Gathering and Analysis

A review of the CAA data gathering system in early 2003 led to a number of enhancements including improved "key word" based data extraction and filtering techniques. The data for the previous year - and new data as it arrived - were then systematically analysed. A detailed report covering the two year period from 1 January 2002 to 31 December 2003 was produced - earlier data were not suitable for detailed analysis. To classify the occurrences the RISG adopted the US Federal Aviation Administration's severity matrix, which categorises events from A (extreme avoiding action necessary to avoid a collision) to D (little or no chance of collision but meets the definition of a runway incursion). This scheme was adopted because it is a tried and tested methodology and it facilitates comparison with US data categorised in the same manner.

## Operational Procedure (AIRCRAFT AND ATC)

Using the information on trends and causal factors identified from the data analysis work, flight crew and controller best practice guidelines have been developed.

A briefing document on Communications Phraseology and Procedures Best Practice which contains examples of standard R/T phraseology, with particular emphasis on conditional clearances, has been produced.

A similar document covering Taxiing Standard Operating Procedures and Recommended Practices, containing

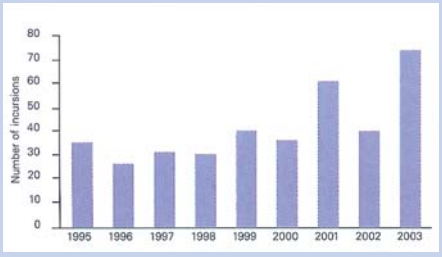
## What the data show

**The data analysis for the years 2002/2003 identified a number of key points summarised as follows:**

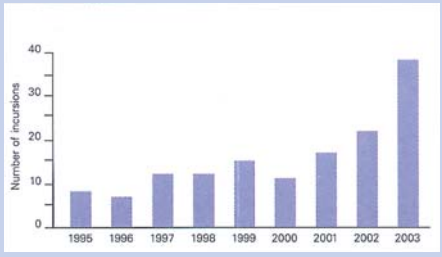
- The number of runway incursions reported at UK aerodromes increased markedly in 2003; 74 occurrences were reported compared with 40 in 2002. This is thought to be due mainly to the increased awareness of the importance of reporting such incidents. A similar effect was observed previously in the "Level Busts" awareness programme.
- The upward trend seen in 2002/2003 was most pronounced at London area aerodromes.
- 67% of incursions involved aircraft/aircraft encounters, 27% involved aircraft/ vehicles and the remaining 6% were encounters between aircraft and people.
- The majority of incursions, around 80%, occurred in daylight.
- 30% of runway incursions involved conditional clearances and in 22% of incidents this was the main causal factor.
- 21% of runway incursions involved pilots crossing red stop bars at runway holding points.
- 14% of runway incursions involved incorrect readbacks from pilots that were not picked up by the controller giving the initial instruction.
- 2 runway incursions were allocated an 'A' risk category, 7 were allocated a 'B' risk category, 40 were allocated a 'C' risk category and 65 were allocated a 'D' risk category. However, the data indicated that the errors/shortfalls which led to the low severity events were similar in nature to those which were precursors of more dangerous incursions.

**The most frequently occurring causal factors are as follows:**

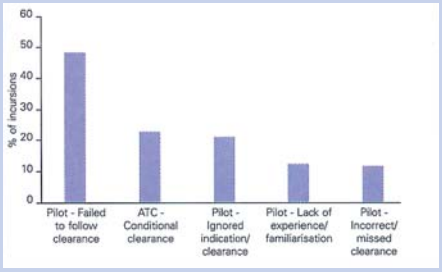
- Misinterpretation of conditional clearances by pilots.
- The issue of ambiguous or confusing conditional clearances by air traffic controllers.
- Inadequate or ineffectual runway and taxiway design and signage, including taxiway markings.
- Lack of, or inadequate, Standard Operating Procedures (SOPs) for pilots in communications (Radiotelephony (R/T) procedures and standards) and taxiing procedures.
- Poor weather conditions leading to lack of visual clues and to disorientation.
- Unfamiliarity with the airport layout (both on the part of pilots and of airside drivers).



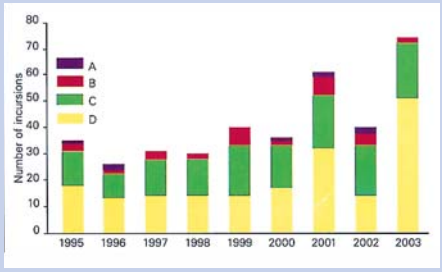

*Runway incursions at UK and Channel Islands licensed aerodromes*



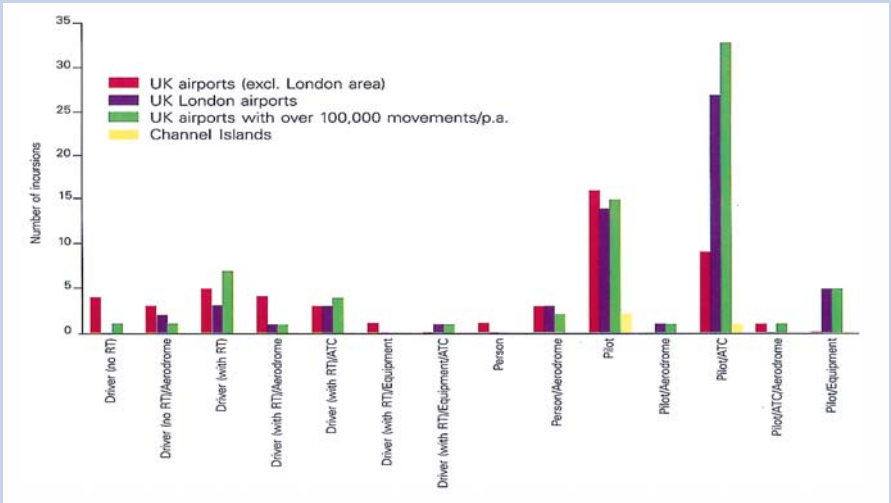

*Runway incursions at London area licensed aerodromes*




*Runway incursions at UK and Channel Islands licensed aerodromes Causal Factors 2002/3.*




*Runway incursions at UK and Channel Islands licensed aerodromes - Risk Category Allocated*




*Parties involved in runway incursions at UK and Channel Islands licensed aerodromes - 2002/3*

*Note: Data from Channel Islands licensed aerodromes was only included in this analysis for the years 2002 and 2003.*

guidance on the safe operation of aircraft on the ground in all weather conditions, has also been produced.

These documents have been issued as attachments to a FODCOM (Flight Operations Department Communication) and although the briefs are aimed at commercial flight operations, pilots of non-commercial flights will no doubt find the content of value. The briefs are available for download from the CAA website.

In addition, the CAA has completed a UK operator survey of Operations Manuals for R/T and Taxiing SOPs which has been used to identify shortcomings in operational practice. A paper on the urgent need for 'last chance' runway protection signs has been prepared for submission to the International Civil Aviation Organization (ICAO) Visual Aids Panel and, finally, a recommendation has been made to introduce an R/T standardisation programme in all UK simulator training.

## Runway Protection Technology Review

The CAA reviewed both currently available technologies and those that are known to be under development. The review determined that the majority of technologies considered offer a limited range of functionality. They are often not designed primarily to prevent runway incursions, but more as components of an Advanced-Surface Movement Guidance and Control System (A-SMGCS).

Data pooling, or 'fusion' systems, combining multiple sensor inputs from different locations on an aerodrome, are currently at various stages of development. Although several show promise, all, at present, appear to have weaknesses that limit their practical application.

It would appear that there is no technological solution that can prevent runway incursions. Technology based systems can, however, provide confirmation of instructions and a positive degree of alerting functionality when incursions are either imminent, or occurring. Because of the diversity of environments that exist at different airports, the CAA is unlikely to mandate any particular system or technology as a universal solution. However, it is likely actively to encourage the implementation of A-SMGCS functionality, which may assist in preventing runway incursions when it can be shown reliably to perform this function.

## Training and Education of Airside Vehicle Drivers

The CAA's Aerodrome Standards Department has been providing advice and information on the risk of runway incursions to aerodrome operators as part of routine audits and visits to aerodromes.

During the current audit cycle, the Aerodrome Standards Department is concentrating on driver training, particularly for those drivers who operate on, or near, runways. Consideration is being given to RT skills and whether such drivers should hold some form of RT licence.

## Airfield Markings Including Signage and Lighting

At an aerodrome, deficiencies in signage, markings and/or lighting can cause pilots or vehicle drivers inadvertently to encroach onto a runway. Where any of these are incorrect, non-standard or confusing, a situation can arise in which a

*Wreckage following the accident at Milan Linate Airport*

pilot or vehicle driver loses situational awareness. This is particularly so when a pilot lacks familiarity with an aerodrome, where non-standard markings or signage are in use or where low-visibility operations are taking place. These conditions can also confuse unwary drivers, no matter how familiar they are with an aerodrome.

During 1999 and 2000, a review of taxiway designation and signage at all UK licensed aerodromes was conducted. At that time a total of 12 (out of 145) aerodromes were found to have systems that did not meet the criteria set out in CAP 168 Licensing of Aerodromes, which themselves reflect the International Standards found in ICAO Annex 14 – Aerodromes. The CAA worked with these aerodromes to achieve compliance with the appropriate standards. With one exception, which is a special case, all licensed aerodromes are now fully compliant.

This initiative was followed up in 2002/2003 with a review that concentrated specifically on runway incursion prevention. The review looked at all access points from taxiways and from airport roads onto runways, to ensure that they were protected by appropriate measures such as guard lights, signs and markings and, where required, stop bars.

The potential for a runway incursion is increased during bad weather. During the current audit cycle a complete review of Low Visibility Procedures (LVP) is being conducted at all aerodromes that have Instrument Landing Systems (ILS), and amendments to the procedures are being agreed with the aerodromes, where appropriate.

## Promotion of Runway Incursion Issues in SMS

The implementation of Safety Management Systems (SMS) is widespread amongst aerodrome operators and air traffic control service provider organisations following the introduction of international standards mandating this approach to managing safe activity. The risk presented by runway incursions is ideally suited to being managed in a systematic fashion by the relevant management organisation. All aerodromes and air traffic control service provider organisations are being encouraged specifically to address runway incursion hazards through their SMS.

## Runway Incursion Awareness Campaign

A co-ordinated programme of work aimed at highlighting the important issue of runway incursions to aerodrome and aircraft oerators is ongoing. Among the activities already undertaken are:


- A runway incursion logo. An easily identifiable and eyecatching logo was developed for use with all publicity material.
- Articles distributed to, and published in, the specialist media. These covered the history of runway incursions, gave an international overview and explained the aims of the CAA action programme.
- A CAA press release on the programme was sent to the specialist media, and featured prominently in a number of publications including Flight International.
- A number of posters have been designed and produced. All feature a different aspect of the runway incursion hazard, aimed at different target audiences. The posters have been despatched to airlines, airport operators and air traffic service providers.
- A runway incursion awareness sticker, designed to be placed on the dashboard of airside vehicles, has been distributed to airport operators.
- A safety leaflet explaining the dangers of runway incursions, was produced and distributed with the February 2004 edition of CHIRP - the confidential human factors bulletin.
- Richard Taylor, Head of the ATS Standards Department, provided BBC TV with a background briefing on runway incursions for a series of programmes on the subject that were broadcast in July 2003.
- Formal notices to industry. Three ATS Information Notices (ATSIN) and a Notice to Aerodrome Licensees (NOTAL) have been issued. These documents highlighted the risks of runway incursions and the availability of information and guidance on the subject. The third ATSIN specifically addressed the hazards associated with conditional clearances in the vicinity of a runway, a factor that was identified as a significant contributor to runway incursion incidents.

### ADDITIONAL RESOURCES

*Many of the items described in this brief, and in particular the runway incursions hazard awareness posters, are available from the CAA website. Additional resources, including The European Action Plan for the Prevention of Runway Incursions developed by EUROCONTROL, and links to materials produced by other States, are also available.*

*The Runway Safety page is at www.caa.co.uk/srg/safety_initiatives/default.asp?page=2370.*

# What is a Level Bust?

*by Richard Schofield, Deputy Watch Manager, Z Watch at LTCC*

The definition of a Level Bust used by NATS is a deviation of 300 feet or more from the assigned level. The Eurocontrol definition of a level bust is an unauthorized vertical deviation of more than 300 feet from an ATC flight clearance (within RVSM airspace this limit is reduced to 200 feet); other states and service providers use their own definition. The use of different criteria makes a direct comparison between the numbers of reported events in each country difficult; it is also difficult to make a direct comparison with airline data for the same reason. The NATS view is that the rate of occurrence in the UK is too high.

## The scale of the problem

The following figures indicate the scale of the problem using NATS own data, based on reports filed by ATCOs under CAP382, the Mandatory Occurrence Report Scheme.

| | |
|---|---|
| 2000 | 291 |
| 2001 | 254 |
| 2002 | 289 |
| 2003 | 203 |
| 2004 | 303 |
| 2005 Jan to Apr 30th | 116 |

The cumulative total for 2005 from January to April is a 33% higher than the same period in 2004 and an 84% increase over 2003. Equally worrying is that the figures for each year don't provide a true indication of the scale of the problem; based on radar recordings and work with operators we believe that only one in three actual events in the UK is reported.

The safety significance of level bust events is also increasing year on year. In the UK, standard radar separation will usually be 1000 feet vertically or 3 miles horizontally; in some areas this is increased to 5 miles. Level busts which result in a loss of separation are increasing. In 2003 there were 31 losses of separation resulting from a level bust, in 2004 this increased to 53, thus far in 2005 there have been 23 losses of separation.

## What are the top causal factors in reported level bust events?

Level bust reports are investigated by the NATS ATC Investigations staff; the majority of these investigations will also

| Top causal factors of level busts, Jan 03 to Apr 05 | % of events |
|---|---|
| **Correct pilot readback followed by incorrect action,** formerly described as CRM problems. Some events in this category will involve occasions where crews have received a clearance to a level which is known to cause confusion such as FL100/FL110 or FL200/220. The UK have introduced non-standard R/T phraseology to overcome this difficulty but the problem is still with us; in 2004 there are 8 recorded occasions where a crew have correctly acknowledged a decent clearance to FL110 but have then descended to FL100. Other events will involve a breakdown in cockpit SOPs; we don't fully understand why this type of event occurs but it is possible that high R/T loading, high cockpit workload and communication issues are all contributory factors. | 20-25% |
| **Mis hear errors** are recorded when an ATCO fails to detect and correct an incorrect pilot R/T read back which is audible. These errors are more common at the ATC centres with high R/T workload but we believe that ATCOs hear and correct more errors than they miss. | 10% |
| **Failed to follow cleared SID** is a particular issue with departures from Gatwick, Stansted and Luton although other airports are affected. Gatwick, Stansted and Luton all have step climb SIDs and these errors normally involve an aircraft failing to stop at the first stop altitude. | 10% |
| **Incorrect pilot readback by correct aircraft** involves a wrong readback of an ATC clearance. | 9% |
| **Pilot readback by incorrect aircraft** means that the crew of one aircraft took a call intended for a different aircraft. | 8% |
| **Poor manual handling** can be due to a pilot's manual handling of the aircraft or input error into the FMS. Two of the most serious level bust incidents in 2004 involved poor manual handling by military pilots. | 7% |
| **Aircraft technical problem** which includes events where the FMS has failed to capture the selected altitude. | 5% |
| **Altimeter setting error** is a problem mainly reported in the London TMA. 80% of the errors occur when the aircraft is in the climb, is above the transition altitude/level and the standard pressure setting isn't set. | 5% |

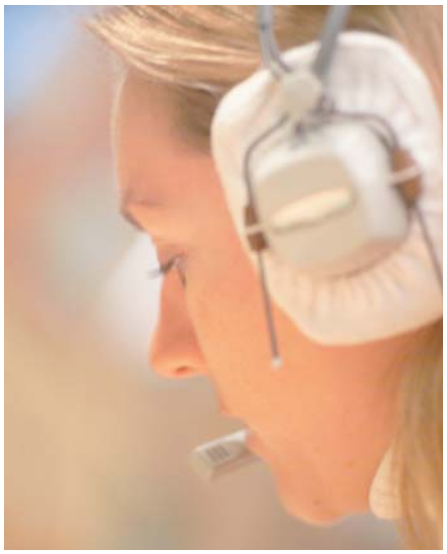
involve contact with the operator. Based on the report, feedback from the operator and the subsequent investigation a causal factor will be assigned to the event based on the NATS Event Factor Description scheme. The top causal factors for level busts since the beginning of 2003 to date have remained broadly similar as has the proportion of events involving each causal factor. A description of the top causal factors with supporting information is given below; the figure in the end box is a guide to the % of reported events which involve each of the causal factors.

## What can be done about level busts by pilots and controllers?

There is no single solution to the level bust problem because there are numerous problems.

Advice for pilots;

- Follow SOPs; full adherence to good SOPs are an excellent first defence.
- If in doubt about a clearance, confirm it on the R/T, not with your colleague.
- Report your cleared level on first contact with a new frequency unless specifically asked not to.



- Maintain a good standard of R/T discipline. Missing out vital information such as a cleared level or your callsign adds to controller workload because they will have to ask you for it.
- Pay attention to SID charts especially where a step climb is involved. On first contact tell the ATC sector your callsign, passing altitude, first stop altitude and SID designator.
- Increase vigilance where traffic density is high. If R/T congestion is a problem, file an MOR.
- If you hear another pilot make an incorrect readback and this isn't corrected by the ATCO then, whenever possible, advise ATC that you have heard a missed readback error.

Advice for ATCOs;

- File a report on any level bust even if separation is not lost. We need to know where and why all level bust events are happening.
- Monitor readbacks. Insist on correct readbacks.
- R/T loading is a factor in level busts and other incidents. Split sectors to reduce R/T loading.
- If pilots don't give their cleared level on first contact then ask them to confirm it.
- Avoid multiple instructions; ideally don't include more than 2 instructions per transmission.
- Use clear and unambiguous phraseology. The introduction of new phraseology for FL100/200 etc has reduced level busts at these levels. In 2002 11% of reported level busts in the UK involved a crew confusing climb or descent instructions with a heading instruction. The best practice at LTCC is to use headings ending in 5 or the word 'degrees' if a heading ends in '0', since January 2004 there have only been 2 level busts with this causal factor.
- Avoid reference to level if giving traffic information; use 'traffic crossing, 1000 feet above/below.'
- Restate the cleared level when asking for requested level. If using 'expect' levels ensure that the 'expect' level precedes the cleared level.

## Next steps?

This short article is intended to raise awareness of the increase in the number of level busts in the UK. We are working in conjunction with operators, regulators and others to tackle the problem and we welcome the opportunity to address operators and safety organisations in more depth about the problem. We accept that we can't provide all of the answers or advice and welcome input from all parties; if you have information or solutions we will be glad to hear them. For further information please contact Mike Edwards (mike.edwards@nats.co.uk), or visit our website, www.levelbust.com where up to date information and help is available including the Eurocontrol Level Bust Tool Kit briefing papers.

## Runway Safety – National Air Traffic Services Activities

Runway Incursions continue to pose a significant threat to Airport Operations. An action from the NATS Safety Review Committee was to form a Focal Group to keep up momentum and co-ordinate the overall NATS plan for preventing runway incursions.

In the first quarter of 2005 there have been 33 reported incursions at Airports where NATS is the ANSP. 10 incursions were reported in April.

The Focal Group has been running for 6 months and has established the following goals –

- GOAL 1 - Develop and distribute effectively Runway Education AND Training materials to controllers, pilots and all other relevant Airport users.
- GOAL 2 - Improve Runway Safety Data collection, analysis, dissemination and learning.
- GOAL 3 - Develop and implement standard operating procedures, monitor and measure compliance with SOPs.
- GOAL 4 –Influence Airport design and environment with regards to Runway Safety.
- GOAL 5 – Develop cohesive relationships within the aviation community to address the issue of Runway Incursions.
- GOAL 6 – Support and deploy new technologies that will reduce and prevent Runway Incursions.

Work is well underway; the group have identified areas of priority which also reflect the current hot topics –

1. The most important aspect of Runway Incursion investigation is the understanding as to why they have occurred. To that end all parties involved in any incursion at an Airport at which NATS provides the ANSP will be invited to complete a Runway Incursion Research questionnaire. ATC units hold supplies of both 'hard' and 'soft' copies of the questionnaire for distribution. Trials at Gatwick have indicated that the feedback 'gleaned' from the questionnaires has contributed significantly to the understanding as to why the incursion occurred.

2. Red stopbars are a final safety net in preventing runway incursions. All NATS airports are currently reviewing local instruction to ensure that Runway Guard Bars would only need to be crossed in the event of a lighting system malfunction and then with the assistance of a follow me vehicle. The message that we will continue to send out to the pilot and vehicle driver community is 'NEVER CROSS A RED STOPBAR'.

3. Conditional Clearances continue to play a part in Runway Incursions. Following analysis of the first quarter of 2005, 33% of all runway incursions involved the use of conditional clearances. What is significant is that in every one of these incidents, the outcome was compounded by an incomplete read-back. The importance of accurate and complete readback cannot be over emphasised and is a particular area of focus for the group.

4. Also of interest in recent incursions is the possible breakdown in understanding with the use of the word 'follow'.

   Two aircraft taxying to holding point A1, the second a/c having received a clearance to follow the A321 to Holding Point A1, resulted in the second a/c incurring as the A321 lined up ahead. The Focal Group have published awareness material for controllers and are currently raising awareness throughout industry with regards to the way in which clearance limits are recorded on the flight deck. Is there an SOP for recording taxy route instructions? Are they always written down? Is the clearance limit always recorded? Is the clearance limit always cross checked as a cleared level would be?

5. Local Runway Safety Teams continue to be proactive at UK airports. NATS is encouraging the use of Aerodrome Resource Management training which enables Pilots, Drivers, Controllers and Airfield ops personnel not only to debate runway safety issues, but also to gain a shared understanding of each others activities in the complex airport environment.

Your support in completing Incursion Research questionnaires will be much appreciated.

Any comments or contribution to the Runway Safety debate can be made to runway.safety@nats.co.uk

## Mid-Air Collisions in the Low Flying System

*By: Mr John Chappelow - Principal Psychologist for The Centre Of Human Sciences at QinetiQ*

**There are four ways to avoid mid-air collisions between aircraft operating in the low flying system:**

**Encourage crews to do better, for example by punishing those that fail.**

**Arrange the low flying system to minimise the probability of confliction.**

**Enhance the effectiveness of the see-and-avoid principle by making aircraft more conspicuous.**

**Introduce collision warning systems.**

The first is an ineffective strategy. There is no incentive more powerful than self-preservation (except, possibly, sex, and that is not an option in most cockpits), and punishment generally does not enhance performance; it fosters anxiety and mistrust.

The second strategy is worthwhile. Halving the number of aircraft in a volume of airspace reduces the risk of confliction by three-quarters, so procedural deconfliction by height bands or timing is effective. One-way flow patterns at choke points also reduce risk. There is an argument that slow movers should be allowed to fly against the flow, thereby increasing the quality of their visual lookout without making much difference to the closing speed. I have made a couple of attempts at estimating the reduction in risk. The argument is logical but so far the advantage does not appear to be so great that a policy decision permitting an exception to the rule is a clear-cut good thing. If you have scope for varying your choice of route or height, you may be able to reduce your personal risk. Choose unpopular heights, like 1,300ft. Interestingly, although fast-jet pilots claim to operate mostly below 500ft and civilians at 1,000ft or above, most fast-jet/general aviation conflictions happen in the gap in between.

There are three basic ways of making a small aircraft more conspicuous: Smoke Trails, Bright Lights, and Paint Schemes. As far as I know, trailing smoke has not been seriously tried. Bright lights work really well. High intensity strobe lights typically emit 2,000 candela. This is not really bright enough to make much difference in daylight, particularly as strobes typically flash for about three milliseconds once a second. If you are looking in the right direction, there is only about a one in three chance that the strobe will flash before your eyes move. Steady lamps emitting 20,000 candela and covering the sector 40° left to 40° right of the nose would reduce the risk for fast-jets by about two thirds. Sadly, this simple measure requires fairly hefty wiring in the wings, so the modification would cost more than you might expect and has not been implemented yet. If your aircraft has fixed landing or taxi lights, switching them on when airborne in daylight could improve your chances by a worthwhile amount.

***"To resolve a confliction with some degree of comfort, you need to detect it at least five second before impact"***

Most aircraft are painted, so any conspicuity benefit due to paint schemes effectively comes free of charge. To resolve a confliction with some degree of comfort, you need to detect it at least five seconds before impact. In fast-jet/fast-jet mid-air collisions (the most common

pairing), the range at five seconds to go is typically so great that the targets appear very small (but they get bigger very rapidly). Painting patterns on a small target is not really helpful. In fact, colour does not help much either. You really need one block of high contrast. Just think of all the long-range detections you have made. Either the aircraft was a dark speck against a bright sky or a very bright speck against a darker background. A white aircraft viewed on a clear day with the sun behind you can have a contrast of five or six. Unfortunately, in other circumstances, its contrast against the sky will be close to zero. A black aircraft manages a contrast of close to minus one in most conditions, so, on average, black works quite well for fast-jets. This is in part because, during the critical last few seconds, the two aircraft will be at more or less the same height. The background behind each will be the distant horizon, which, even if it is a pine-clad mountain, will, because of atmospheric scattering, generally tend to be about as bright as the horizon sky. This is why RAF Hawks and Tucanos are black. It is not so simple for helicopters. In many circumstances, the same considerations apply. But a black helicopter could disappear by hovering over a pine forest. And, of course, where many helicopters are operating in the same area, at a variety of heights and, perhaps, practising autorotations, some conflictions will involve a vertical component. One of the aircraft will be viewed against a terrain background. For this reason, the Defence Helicopter Flying School and many Police helicopters have a paint scheme that is mainly black from

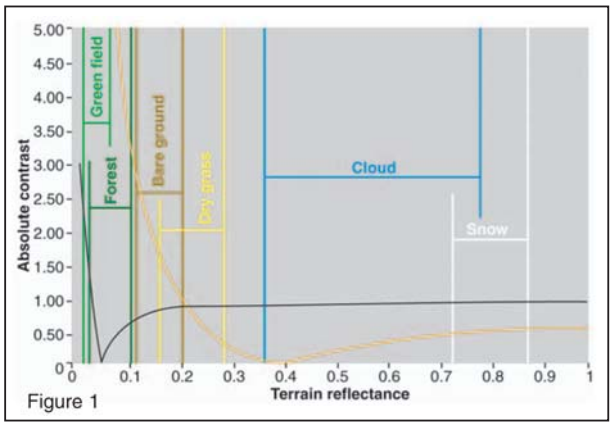


Figure 1

the sides and mainly bright yellow from above. This is a compromise; on the basis of studies so far, a fairly good one. Figure 1 shows how the absolute intrinsic contrast of black and yellow paint varies against a variety of backgrounds and illustrates the truism that any paint scheme can be conspicuous in some places and a camouflage in others. Hence, compromise is unavoidable.

In theory, we can add an extra, special conspicuity measure for helicopters – rotor flicker enhanced by painting the blades different shades. There has been a little work on this option showing a potential advantage. Measuring the practical conspicuity benefit in realistic conditions is a tricky proposition, but the DASC are investigating a study into rotor blade conspicuity which should report in late autumn. This will mainly benefit the training helicopter fleet, by making them more observable from above while operating in the low level environment.

Collision Warning Systems are the hi-tech answer to mid-air collisions and now provide a significant measure of protection in civil air transport operations.

The civilian system, with its complex displays and avoidance manoeuvre commands is probably not suitable for the low-level environment without considerable modification. Two options are under consideration for fast-jets.

An option based on interrogating IFF transponders offers the possibility of detecting both military and civil traffic. It is currently seen as an adjunct to the see-and-avoid principle. For example, a voice warning could direct the pilot's eyes towards the intruder so that he can take appropriate avoiding action. It would be important to minimise the false alarm rate in such a system for obvious reasons. This has implications for the time at which the alarm is triggered. Do it too early and the pilot may not detect the other aircraft in a reasonable time of searching. Not only would that alarm fail to achieve its purpose, but it would add to the impression of a faulty system. Modelling taking account of the psychophysics suggests that the optimum time is at around seven seconds from impact. That would allow two or three seconds to search when the target was becoming reasonably detectable and four or five to respond and achieve an effective change of trajectory.

The second option could cost less because it is a capability of the RAIDS pods being acquired for fast-jets in support of combat training. This system cannot direct the pilot's eyes towards the intruder; it merely indicates that collision is imminent. It would not be an adjunct to the see-and-avoid principle, but could support a different principle, a standard manoeuvre in reaction to a voice warning. Two parameters define the warning system: how far ahead in time it predicts aircraft trajectories and the size of the bubble it uses to trigger the alarm. These have to be chosen with care. Modelling has shown that it is possible to make matters worse (conflictions get closer) in as much as 40% of cases. However, if the prediction time is about five seconds and the bubble radius is set to the minimum consistent with the error margins of the system, the outcome should generally be positive – as long as pilots react quickly. There are some other provisos, but a system like this could be effective in resolving about half of fast-jet/fast-jet conflictions.

***"The principal unknown quantity at present is the increase in risk of a militray/general aviation collision"***

The risk of a military/military mid-air collision is reducing as the number of hours flown reduces. Measures like the ones described above are helping to accelerate that reduction. The principal

unknown quantity at present is the increase in risk of a military/general aviation collision due to greater numbers of very small civil aircraft operating in the low flying system – micro-lights, hang-gliders, etc. Accurately modelling and reducing that risk is a new challenge.

*Reprinted with acknowledgement to Aviate*

# UK FLIGHT SAFETY COMMITTEE

# AVIATION SAFETY - LOOKING AHEAD 20 YEARS

## Annual Seminar 2005

**3rd & 4th October 2005**
**The Radisson Edwardian Hotel, Heathrow**

## SEMINAR OBJECTIVE

If you want to understand more about the problems, and consider solutions, created by the development of: Aircraft Systems, Aircraft Types, Crew Composition, Legal & Regulatory issues, Air Traffic Management, Engineering, Training, Ground Handling and Security then you must attend this Seminar.

## PROGRAMME

### 3rd October 2005

2000hrs Seminar Dinner
After Dinner Speaker - Ken Smart

### 4th October 2005

| | |
|---|---|
| 0800 - 0900 | Registration |
| Session Chairman - Ian Crowe - Willis | |
| 0900 - 0915 | Welcoming Introduction - Stuart McKie-Smith - Chairman, UKFSC |
| 0920 - 0955 | Keynote Speech - Dr Kathy Abbott - FAA |
| 1000 - 1035 | ATM Future Development - Mark P. Green - VP Policy GATCO |
| 1035 - 1055 | Refreshment Break |
| 1055 - 1115 | Setting the Sights for the Future in a Changing Environment - Thor Johansen - Boeing |
| 1120 - 1155 | ICAO'S Multi-Crew Pilot Licence (MPL) - Graham Forbes - CAA |
| 1155 - 1230 | Questions |
| 1230 - 1340 | Lunch |
| 1340 - 1415 | Human Factors in Aviation - John Chappelow - Qinetiq |
| 1420 - 1455 | Airport Development & Ground Ops - Peter Hampson, Airport Solutions Ltd |
| 1455 - 1510 | Comfort Break |
| 1510 - 1545 | Passenger Handling & Airport Security - Richard Doney - TRANSEC |
| 1550 - 1625 | The Legal Minefield - Simon Phippard |
| 1625 - 1655 | Questions |
| 1655 - 1700 | Closing Speech - Chairman UKFSC |

## SEMINAR INFORMATION

- Hotel Accommodation

Hotel Accommodation is not included in the Seminar Registration Fee. A rate of £147 (including breakfast & VAT) has been negotiated with the Radisson Edwardian Hotel (valid only until 26th August). If you require accommodation please contact the hotel directly on Tel: +44 (0) 20 8759 6311 and quote Block Booking Code 1003 UKF when making your reservation.

- Seminar Dinner

Dress for Dinner - Black Tie

- Cancellations/Refunds

Cancellations received prior to 26th August 2005 will be refunded 50% of registration fee. Refunds after this date

## SEMINAR REGISTRATION FORM

Please complete in full one registration form per person. (Photocopies accepted)

(Please print clearly)

First Name: Surname:

Company: Job Title:

Address:

Tel No: Fax No:

e-mail:

### PAYMENT INFORMATION

Fee: £175 UKFSC Member ☐ £225 Non-UKFSC Member ☐

This includes the Seminar Dinner on the evening 3rd October, lunch, refreshments and car parking. This does not include hotel accommodation - please see 'Seminar Information'.

Payment is by Sterling cheque only. No credit cards are accepted. Bank transfer is available, details on request (please note an additional cost of £6 will be added to cover handling charges). The UKFSC is not VAT Registered.

Sterling cheques should be made payable to UK Flight Safety Committee.

- Do you plan to attend the Seminar Dinner on Monday 3rd October? Yes ☐ No ☐
- Do you require a Vegetarian alternative? Yes ☐ No ☐

PLEASE SEND YOUR COMPLETED REGISTRATION FORM WITH YOUR CHEQUE TO:
UK Flight Safety Committee, Graham Suite, Fairoaks Airport, Chobham, Woking, Surrey, GU24 8HX.
Tel: +44 (0)1276 855193 Fax: +44 (0)1276 855195 email: admin@ukfsc.co.uk
Confirmation will be sent to you on receipt of your Registration Form and payment.

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