ISSUE 86

# focus

ON COMMERCIAL AVIATION SAFETY

SPRING 12

The official publication of the United Kingdom Flight Safety Committee

ISSN 1355-1523

# Contents

The Official Publication of THE UNITED KINGDOM FLIGHT SAFETY COMMITTEE ISSN: 1355-1523 SPRING 2012

**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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Web Site: www.ukfsc.co.uk
Office Hours: 0900 - 1630 Monday - Friday

Printed by:
Woking Print & Publicity Ltd
The Print Works, St. Johns Lye, St. Johns, Woking, Surrey GU21 1RS
Tel: 01483 884884 Fax: 01483 884880
e-mail: sales@wokingprint.com
Web: www.wokingprint.com





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# To Err is human (Errare est humanum)

by Steve Hull, Vice-Chairman UKFSC

**As Rich (our Editor) departs for pastures new, or pastures old as he will be employed by the CAA, I was asked to write the next editorial for FOCUS magazine. I did ask if there was a particular topic to write about and was informed to concentrate on something topical.**

So here goes; it is not often that a disaster has everyone forming an opinion so quickly after the event, but that has certainly happened as a result of the Costa Concordia striking rocks and running aground close to Giglio Island, off the Italian Tuscan coast. Just three hours into the cruise and disaster struck, but unlike UK law, in accident investigation you seem to be guilty before being proven innocent. The passenger stories that ranged from an orderly abandonment of the ship to absolute chaos, plus the incredible pictures, have heightened the anxiety and placed increased pressure on the Costa organisation to act, but the image of the Chief Executive blaming the Captain the day after the accident, to anyone involved in safety, safety management or accident investigation was astonishing.

The good news in aviation is we generally give it a week before the so called experts and newspapers start their attack, but the Costa Concordia accident re-emphasises the importance of the need of a positive safety culture in any transport company. The introduction of safety management systems is slowly becoming the way forward, but the more interesting point is, why do people break rules?

I do not know of a pilot, engineer or air traffic controller (and putting that into marine terms Ship's Captain or Navigating Officer) who sets off to work believing they would make a mistake or a serious error of judgement. Professionals usually start the day with the understanding that they will do their best. Generally, mistakes that are made are due to procedures not being followed. Often this is because the procedures are incorrect, unclear or burdensome. Or more commonly it has become the way of doing things, or the task cannot be completed without breaking the rules.

The majority of people break rules and cut corners for what they see as good reasons, this is often in an attempt, with the best will in the world, to get the job done. Nevertheless, it is often problems with the procedures, rather than the attitude of the individuals that form the major reason for rule breaking. These problems affect the ability of people to adhere to the rules or procedures, and may create a culture in which rule breaking becomes an accepted practice; this is commonly called 'normalisation of deviance.'

So we have established that errors will happen and that people will break rules so how do we prevent this from happening?

At first sight, human error appears to be quite complex and highly unpredictable. As a result, many managers surrender to the apparent inevitability that errors will happen and opt for the easier solution of allocating blame, which is the simplistic way of dealing with a difficult problem. Blame places the responsibility for an error with the individual making the error. This removes the need to understand why the error occurred, since it is believed future errors can be prevented by punitive measures against the unfortunate individual. If the error was system induced, as most errors are, then this solution to the problem will always be unsuccessful. The defective system will remain uncorrected and it is only a matter of time before another error occurs, by the next unfortunate person who happens to be exposed to it. But, more importantly, all systems must have defences and safeguards, so when an event occurs, the most important issue is not who made the mistake, but how and why the defences failed. This is not to say that there is no place for blame. There most certainly is, but the important point is that the blame is attributed where it is deserved. There will always be cases where the individual making the error deservedly attracts some blame. There may be an element of carelessness, inattention, negligence or deliberate violation of procedures that must be dealt with. However, it is important that this is addressed as a secondary issue subservient to a thorough investigation of the possible systemic causes of the error.

On many occasions the individual targeted for blame, is blamed before the investigation has been completed or in the Costa Concordia accident, before the investigation has started. 'It is their fault, they were in charge.' Ritual hanging and leaving the body for all to see stopped hundreds of years ago, but the mentality remains. In the desire to make processes work quicker, expediency wins the day. It may not be right but it is to the organisation's advantage.

All airlines, shipping companies, in fact all businesses must appreciate that human error is unavoidable and that it is the responsibility of an organisation to effectively manage those errors, not blame individuals for making them. Moreover everyone needs to understand that the 'Blame Game' never benefits the cause of improved safety.

# Caution and Care

by Capt. Tony Wride, Monarch Airlines

**Welcome to my penultimate column which I hope you will find interesting and perhaps even thought provoking.**

As we say farewell to our outgoing Chief Executive Air Commodore Rich Jones and wish him well we also say welcome to our new Chief Executive, Air Commodore Dai Whittingham. He joins us after a long and successful career in the Royal Air Force, during which he flew a number of different aircraft from Phantoms to AWACs, was an A2 QFI, and progressed to attain the rank of Air Commodore. We look forward to working with him.

Those of you who have read my previous columns will know that I have always had a safety concern about where the Commercial Aviation industry is heading, particularly in these times of steep competition and reduced revenue. It is always of concern when employers have to make cost savings and are constantly on the lookout for areas to save. One such area is training.

The effectiveness of every role within the aviation industry needs to be underpinned by well thought out, structured, easy to assess and relevant training. Training has to be fair and equitable and the methodology employed to determine success has to be transparent. But more than this, it has to be applied. Safety and risk are only understood and mitigated if those involved in work areas of risk have had sufficient good quality training to ensure they can deal with all eventualities. Constant inspection and compliance instead of training undermines the rationale for training and undermines the confidence of the workforce. Once confidence has been lost the trainer has created an unsafe worker and has responsibility for any untoward events occurring as a result.

In this time of recession and cutbacks, it's easy for employers to think training is a cost that can be cut until times are better. However from a cost/benefit/cost perspective training is the linchpin that ensures stability in tough times and continually reduces risk, which in itself is a cost saving. The adage 'safety is no accident', is more relevant in times of austerity because to ensure accidents don't happen we have to continue to pay out for effective training. It's also important to remember that the Swiss Cheese model dictates that it's not just front line staff who need to have ongoing training, but all staff throughout the operation.

Having started on the subject of training it is worth considering the quality of the training given to new pilots and also the continuation training once they join an airline. Everything depends on how good the initial training is and to a large extent the quality of the trainers both during the pilot's initial training and subsequently. I still vividly remember going through both my Qualified Helicopter Instructor and Qualified Flying Instructor course where we were shown the various types of Instructor. As a classic example they used a piece from a television series called "Fighter Pilot" which followed a group of prospective RAF pilots under training. There was one particular piece where the Instructor did nothing but 'verbally abuse' (including shouting at) the trainee whilst trying to teach and fly a circuit detail. As my course instructors highlighted, any idiot can criticise, nitpick, shout and scream, and destroy a trainee's confidence. However, it takes the right attitude and an understanding of the role of the trainer to get the best from a trainee and not everyone is cut out to train.

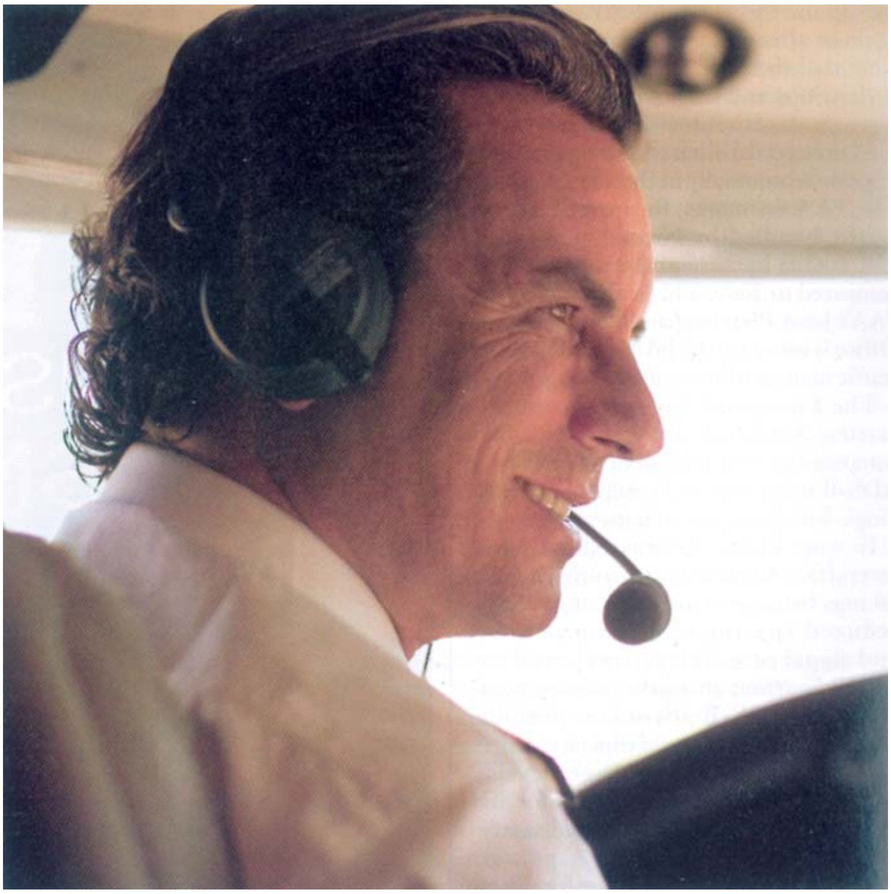
In the Commercial Aviation world it would be good to think that the days of the trainer who was 'out to get you' by loading you up until you broke are long gone. All training should be a developmental process whereby individuals have a clear progression route for increasing knowledge and expertise leading to the development of experience and competence. The research conducted by Drefus and Drefus(1980) using aircrew, demonstrates the need for a fuller understanding of the stages of developmental learning as defined by them. In the novice stage, a person follows rules as given, without context, with no sense of responsibility beyond following the rules exactly. Competence develops when the individual develops organizing principles to quickly access the particular rules that are relevant to the specific task at hand; hence, competence is characterized by active decision making in choosing a course of action. Proficiency is shown by individuals who develop intuition to guide their decisions and devise their own rules to formulate plans. The progression is thus from rigid adherence to rules to an intuitive mode of reasoning based on tacit knowledge. They define an expert as someone who transcends reliance on rules or guidelines, and maxims, has an intuitive grasp of situations based on deep, tacit understanding, has a vision of what is possible and uses analytical approaches in new situations or in case of problems i.e. a higher level of risk management.

The research clearly shows that if, as part of the training process, an experienced pilot is taken back to the beginning in terms of what they've been taught i.e. the novice pilot, they will ignore and/or forget everything they have learned in order to become experienced. This is why it's crucial that all training is developmental. Furthermore it is imperative that trainers understand why pilots make the decisions they do before judging the decision as flawed, particularly as there is a tendency to judge the pilot instead of the decision. This is the trainers' responsibility not the trainee's. The training process and the trainer need to have a full understanding of where a pilot is in terms of his experiential learning and continue to develop his ability to think critically. The assessment process needs to be able to assess expertise and trainers need to acknowledge that the 'trainee' may be on a higher cognitive plain than the trainer.

In India recently I saw the following on a road sign, 'Caution and Care make Accidents Rare'! It is the responsibility of the training function within any organisation to ensure that every individual has training which enables them to manage risk in their area of work. Training must instil 'caution and care' at every level and will by default ensure accidents continue to be rare.

# Fatal Distractions

by David Carlisle



**Too many aviation accidents result in part from distractions, interruptions or preoccupation with nonessentials. What is essential is staying focused.**

The deadly loss-of-control accident of a Colgan Air Bombardier DHC-8- 400 on Feb 12, 2009, during a night instrument approach to Buffalo Niagara International Airport again makes it clear that cockpit distractions during critical phases of flight represent a substantial risk to aviation safety. Both pilots, two flight attendants, 45 passengers and one person on the ground were killed when the Continental Connections Flight 3407 slammed into a residential neighbourhood five miles short of the airport.

While training, fatigue and general competency were likely causes of Flight 3407's crash, contributing to some degree was the pilots' conversation about nonpertinent matters, creating an environment that impeded timely error detection.

As such, the crew failed to notice the decreasing margin between IAS and the low-speed cues, the changing color of the numbers on the IAS display and the excessive nose-up pitch attitude, all of which would have given them adequate time to initiate corrective action. When the stick shaker activated, the captain's improper aft control column inputs led to an accelerated stall from which they could not recover.

## Task Management

The Buffalo accident is the most recent in a number of high-profile crashes involving a breakdown in sterile cockpit procedures, and the FAA wants the aviation community to take corrective action.

Our best understanding of why routine conversations can interfere with monitoring or controlling the aircraft comes from studies on task management.

But cockpit conversation is not the only cause of distractions or preoccupation among flight crews. Radio communication, head-down work such as programming the FMS or reviewing approach plates, searching for VMC traffic or responding to abnormal situations have all led to distractions that have caused incidents and accidents. A disregard for SOPs is the common thread revealed among these broad categories.

While many claim easy mastery at multitasking, cognitive research indicates that people are able to perform just two tasks concurrently and only in limited circumstances, even if they are skillful in performing each task separately. It is generally accepted that humans have two cognitive systems with which they perform tasks - one involves conscious control, the other is an automatic system that operates largely outside of conscious control.

### Use the ASRS

According to NASA Ames Research Center, pilot distractions are an accident category that is difficult to measure. As such, assembling data about distraction events is the only way to understand the risk fully so as to create strategies to defeat the problem. If you have a cockpit distraction that leads to a miscue, do make use of the NASA Aviation Safety Reporting System (ASRS). It captures confidential reports, analyzes the resulting aviation safety data and disseminates this critical information to the aviation community. Go to asrs.arc.nasa.gov for more information.

The conscious system is slow and requires effort; it basically performs one operation at a time, in sequence. Learning a new task typically requires conscious processing, which is why learning to drive a car or fly an airplane at first seems overwhelming: The multiple demands of the task exceed conscious capacity. Automated cognitive processes develop as we acquire skill; these processes are specific to each task, operate rapidly and fluidly, and require little effort or attention.

Many real-world tasks require a mixture of automatic and conscious processing. A skillful driver in a familiar car traveling along a familiar road can perform largely on automatic, leaving enough conscious capacity to carry on a conversation. However, if the automatic system is allowed to operate without any conscious supervision, it is vulnerable to certain types of error, especially a type of error called habit capture.

For example, if we intend to take a different route home from work, we are prone to miss our turn off and continue our habitual route if we do not consciously supervise our driving. Also, if we encounter a section of road that is difficult to navigate, we find that we cannot continue the conversation without risking errors in the driving. This is because the automatic processes are not adequate to handle the unpredictable aspects of the driving task.

Conscious control is required in four situations: (1) when the task is novel; (2) when the task is perceived to be critical, difficult or dangerous; (3) when an automatic process must be overridden to prevent habit capture; or (4) when choosing among competing activities. The required mixture of automatic and conscious processing varies among tasks, and the mixture may vary with the moment - to -moment demands of a given task.

## Distractions' Grim Toll

According to a NASA study, distractions and interruptions while taxiing to the active are legion and have caused numerous flight crews to improperly configure their aircraft for takeoff. The study demonstrates that these events are more frequent than previously thought, because often the flight crews recover before something terrible happens. Consider the following:

A Boeing 737-800 was taxiing for takeoff at a major U.S. airport and there was confusion about the cleared route to the runway holding point. Then, according to a report filed with NASA's Aviation Safety Reporting System, "We were cleared for takeoff from Runway 1, but the flight attendant call chime wasn't working. I had called for the before takeoff checklist, but this was interrupted by the communications glitch. On takeoff, rotation and liftoff were sluggish. At 100 to 150 feet, as I continued to rotate, we got the stick shaker. The first officer noticed the no flap condition and placed the flaps to five."

- On Aug. 16, 1987, Northwest Airlines Flight 255 crashed during takeoff at Michigan's MBS Midland Saginaw International Airport, killing the entire crew and all the passengers except for a four-year-old girl. The McDonnell Douglas MD-82 began its takeoff rotation but never achieved liftoff and stalled. The jet rolled 40 degrees to the left, struck a light pole with its left wing near the end of the runway, then struck the roof of a car rental building, and crashed into an expressway. The NTSB said, "The probable cause of the accident was the flight crew's failure to use the taxi checklist to ensure the flaps and slats were extended for takeoff. Contributing to the accident was the absence of electrical power to the airplane takeoff warning system, which did not warn the flight crew that the airplane was improperly configured for takeoff."
- On Aug. 20, 2009, a Spainair MD-82 crashed during takeoff from Madrid Barajas Airport in Spain. All six crewmembers and 154 of the 166 passengers were killed. The accident occurred because the crew failed to select the flaps to the takeoff setting. Investigators are also trying to understand why the takeoff configuration warning system did not alert the pilots to their omission.
- On the night of Feb. 10, 2010, a Boeing 737-300 took off from a taxiway at Amsterdam's Schiphol Airport en route to Warsaw. Flight KL1369 was supposed to use Runway36C but instead the crew took off from taxiway B, which runs parallel to it. There was good visibility and weather conditions at the time.

## Loss-of-Control Accidents

William Bramble, the NTSB's senior human performance investigator, said that all recent fatal airline accidents caused by pilot disorientation were preceded bycrew distraction or fixation on an issue other than flying. This is most common when the distraction occurs just before or during a turn at night or in IMC. Consider the following:

The final report on the 2004 Flash Airlines Boeing 737-300 crash into the Red Sea shortly after takeoff from Sharam el-Sheikh International Airport confirmed that the captain was performing a climbing turn at night over the water when he lost control of his aircraft due to disorientation. The report states that there is no clear proof of exactly what happened, but it suggests the captain became disorientated as a result of distraction by minor faults, which would make distractions the primary cause and disorientation a contributory cause. All six crewmembers and all 142 passengers were killed in the crash.

- On Aug. 23, 2000, a Gulf Air Airbus A320 plunged into the sea two miles northeast of Bahrain International Airport, killing all 143 passengers and crewmembers. The crash occurred one hour after sunset. According to the final report, "no single factor was responsible for the accident." Investigators stressed the need for optimal CRM and cockpit workload management.
- On the night of Dec. 29, 1972, the flight crew of Eastern Air Lines Flight 401 crashed their Lockheed L-1011 into the Florlda Everglades, killing 101 crew and passengers. In determining the probable cause of the crash, the NTSB cited, "the failure of the flight crew to monitor the flight instruments during the final four minutes of flight and to detect an unexpected descent soon enough to prevent impact with the ground. Preoccupation with a malfunction of the nose landing gear position indicating system, a burned-out light bulb, distracted the crew's attention from the instruments and allowed the descent to go unnoticed."

An experienced pilot can manually fly a familiar aircraft in a largely automatic fashion. However, certain subtasks embedded in the act of flying manually require conscious attention. For example, leveling off at an assigned altitude requires consciously monitoring the altimeter to read the numbers and match the current altitude with the assigned altitude the pilot is holding in memory.

The framework outlined above allows some general conclusions about the circumstances under which two tasks may be performed concurrently. A task requiring a high degree of conscious processing, such as FMS programming, cannot be performed concurrently with other tasks without risking error. Two tasks that are largely automated can be performed together reliably if they are regularly practiced in conjunction - for example, flying the aircraft manually and intercepting the localizer.

Researchers are less certain how well individuals can combine two tasks that involve a mixture of conscious and automatic processing - for example, searching for traffic while monitoring for altitude capture. Pilots can probably learn to integrate two tasks of this sort and achieve reliable performance, but only if they regularly practice them in conjunction. This, however, is speculation and requires experimental research for validation.

## Focused and Professional

To act as a skilled pilot -in-command, you must develop the critical command authority skills necessary to effectively manage your flight. The first skill is to keep the goal of safety uppermost in your mind and have it drive all aspects of your planning and actions.

Aviation managers must put forth the effort and provide explicit directions to their crews regarding sterile cockpit discipline. The pilots need to understand that any deviation can result in a significant deterioration of SOPs and CRM, including workload management and aircraft monitoring.

Complex and dynamic situations are a way of life in the cockpit. Recognize when distractions in the cockpit are pushing tasks to overload levels. If too much is happening for safety to be maintained, take action in a timely and decisive manner and slow down. If possible, simplify your procedures and checks. And keep the chatter focused on the tasks at hand. Keep things professional.

To broaden and deepen your safety culture, embrace a philosophy that extols CRM and encourages first officers to effectively intervene when any situation demands input from the right seat. This will always create a multiplier effect on safety.

The golden rule of-cockpit priorities is to "aviate, navigate and communicate."

By adhering strictly to that time -proven order, conscious control and, therefore, flight safety is assured. Save chatter about whatever else for the van ride to the motel.

***Reprinted with kind permission of Aviation Week, Business & Commercial Aviation July 2010***

## Digital Distractors

On April 26, the FAA issued an Information for Operators (InFO 10003) advisory which stresses that use of personal electronic devices (PEDs) for activities unrelated to flight duties constitutes a safety risk.

In issuing the document, the agency noted that recent incidents and 'accidents indicated crew use of PEDs, including laptop computers and mobile telephones, for personal use. For example, in October 2009, as the pilots of a Northwest Airlines flight were using laptop computers to explore new crew scheduling software, they lost situational awareness and bypassed Minneapolis-Saint Paul Airport, their intended destination, by 150 miles.

While acknowledging that PEDs, laptops and 'electronic flight bags can be valuable tools in aviation, the agency wants operators to review and reinforce policies, guidance and crew training to ensure that using such devices does not interfere with cockpit duties. The agency further emphasizes that the sterile cockpit rule prohibits pilots from performing duties unrelated to safe operation
of aircraft during critical phases of flight.

To view InFO 10003, go to www.faa.gov/other_visitjaviation_industry/airline_operators/airline_safety/info

**Frances Fiorino**

# Oceanic Operations – Have You Updated ATC?

by Gavin Dixon, Safety Co-ordinator, Prestwick Centre

**NATS and their Airline customers are working closely together through the SPA (Safety Partnership Agreement) to identify and resolve safety issues such as those experienced in the Oceanic environment. One of the areas the SPA is focusing on is improving awareness for controllers and pilots of the broader environment within which they operate. This SPA article looks at how Oceanic Operations differ from domestic operations due to the lack of radar coverage and VHF communication.**

Although separations are larger than those applied in domestic airspace, any deviation by an aircraft from its planned flight profile or any loss of separation can remain undetected and hence unresolved for an extended period of time. In particular, there is an ongoing issue, common to all the NAT ANSP's, with aircraft flying undetected at the wrong height – these are termed Large Height Deviations (LHDs) – and mean that operations over the North Atlantic do not meet the ICAO Target Level of Safety (TLS) in the vertical dimension.

Oceanic control has many limitations; namely no radar, HF communication and the use of (large) procedural separations. The three types of procedural separation are:

- Vertical separation; the specified spacing of aircraft expressed in altitudes or flight levels.
- Lateral separation; the specified spacing between aircraft expressed in terms of distance or angular displacement between tracks.
- Longitudinal separation; the specified interval between aircraft expressed in units of time or distance along track.

In addition to these, the Reduced Longitudinal Separation (RLong) trial commences on March 30th in both Gander and Shanwick airspace.

## Vertical Separation

Vertical separation used within Shanwick is no different from vertical separation used within domestic airspace:

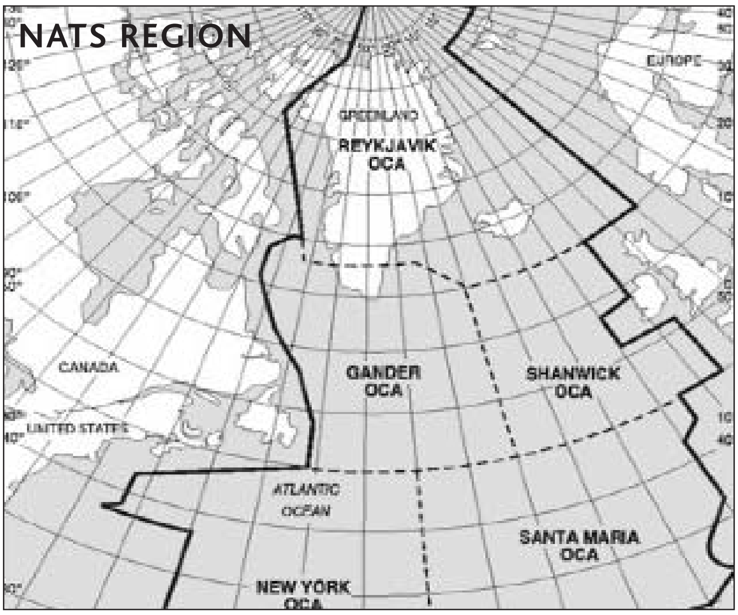
- 2000 ft at or above FL 290, or
- 1000 ft from FL 290 to FL 410 inclusive between RVSM aircraft,
- Or 1000 ft below FL 290

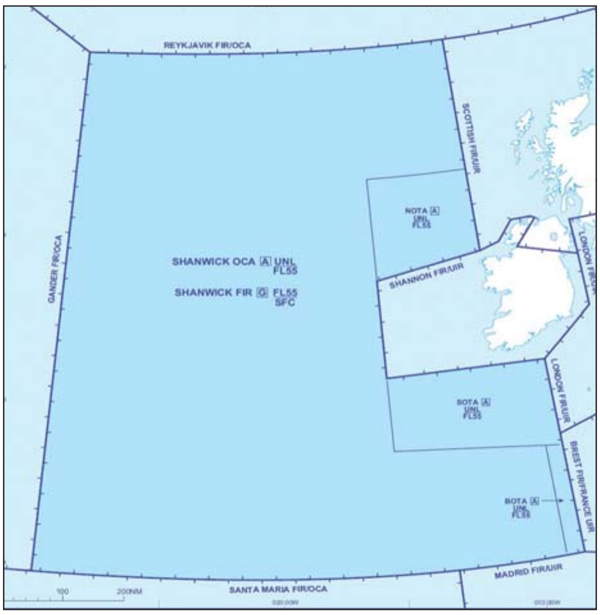
## Lateral Separation

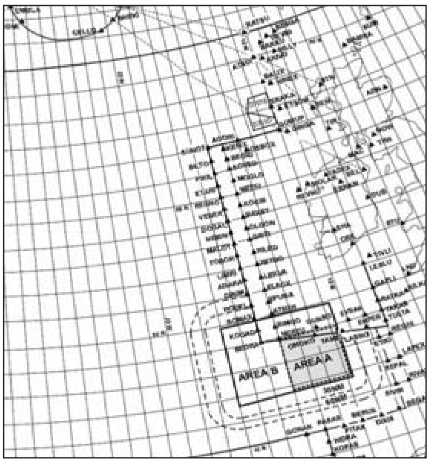
Lateral Separation is applied between route segments. Segments may be wholly or partly separated but for aircraft to be laterally separated, both must be within the separated segments or segment parts. Minimum lateral separation used within Shanwick shall be:

- 60nm or 1 degree of latitude between aircraft, which meet the MNPS, provided that a portion of the route of the aircraft is within, above, or below MNPS airspace.
- 120nm or 2 degrees of latitude between other aircraft.

In the practical application of the 60/120nm criterion, lateral separation may be applied between aircraft operating on non-intersecting tracks which at no point are separated by less than 60/120nm; except that tracks may be spaced with reference to their difference in latitude, using one/two degrees instead of 60/120nm based upon a procedural separation rule known as the Gentle Slope Rule.






## Gentle Slope Rule

Tracks may be spaced with reference to their difference in latitude, using one/two degrees instead of 60/120nm provided that in any interval of ten degrees of longitude the change in latitude of at least one of the tracks does not exceed:

- Three degrees at or South of 58N
- Two degrees North of 58N and South of 70N
- One degree at or North of 70N and South of 80N
- If these limits are exceeded 60/120nm must be applied.
- At or North of 80° North, or where the above rates of change of latitude are exceeded, 60/120nm lateral separation minima must be applied.

## Longitudinal Separation

Longitudinal separation is applied so that the spacing between the estimated positions of the aircraft being separated is never less than a prescribed minimum.

Aircraft shall adhere to the Mach Number approved by ATC when Longitudinal Separation Minima is applied using the Mach Number Technique, and shall request ATC approval before making any changes thereto. If it is essential to make an immediate temporary change in the Mach Number (e.g. turbulence), ATC shall be notified as soon as possible that such a change has been made.

If it is not feasible, due to aircraft performance, to maintain the last assigned Mach number during en-route climbs and descents, pilots of aircraft concerned shall advise ATC at the time of the climb/descent request.

## Mach Number Technique

The term used to describe the technique of clearing turbojet aircraft operating along the same track or continuously diverging tracks to maintain specified Mach numbers in order to maintain adequate longitudinal separation between successive aircraft at, or climbing or descending to, the same level.

The Longitudinal values used within Shanwick vary dependant upon a variety of factors such as:

- Same direction or Opposite direction
- Aircraft Mach number/True airspeed variants
- MNPS or Non MNPS certification
- Turbo jet or non Turbo jet
- Whether flights have reported over a common point, and
- Regarding Reduced minima criteria (RLONG):
  Aircraft CPDLC and ADS capabilities.

## Reduced Longitudinal Separation Trial

RLongSM (Reduced Longitudinal Separation Minimum) is a reduction in the longitudinal separation standard which is achieved by utilising ADS-C (ADS-Contract) periodic position reports.

It is anticipated that the use of RLongSM will enhance the provision of fuel efficient profiles, by accommodating mid-ocean altitude changes.

The RLONG trial will be introduced Bi-Laterally – Eastbound and Westbound (from the 30th March 2011)

## Criteria for RLONG

RLong separation is only to be applied when all flights with less than standard separation meet the following RLongSM criteria;

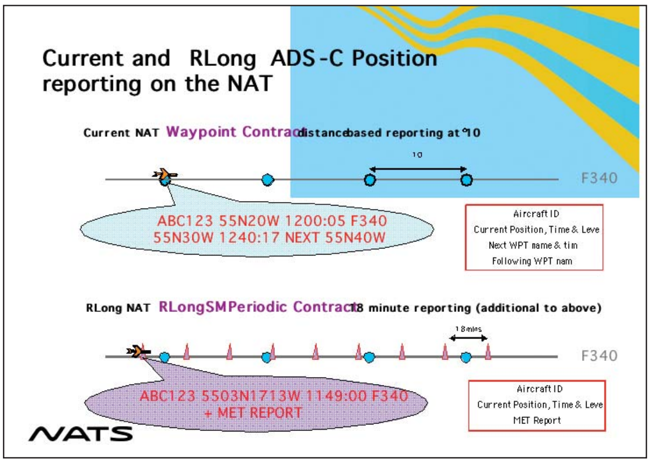
- Flights are MNPS certified
- Periodic contracts – 18 minutes have been established
- Active CPDLC connection
- Eastbound flights remain within trial area and exit into Domestic airspace (Scottish, Shannon, Brest, Madrid)
- Westbound Flights remain within the trial area exiting into Gander or Montreal domestic airspace

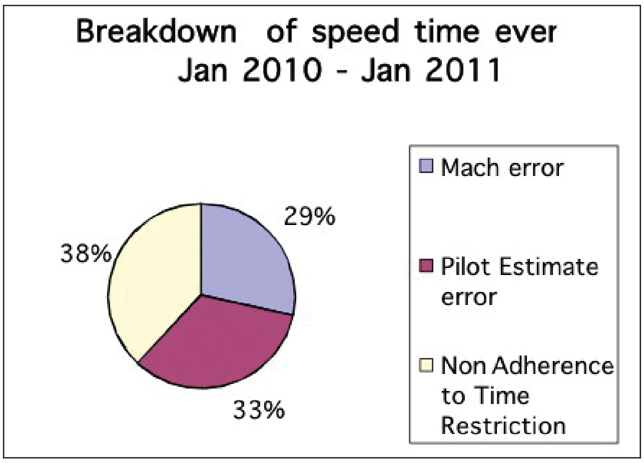
Provided that all the criteria specified is met, RLong Separation allows for standard longitudinal separation (in certain circumstances) to be effectively halved (to a value of not less than five minutes flying time) between flights operating, during their En Route phase of flight, within the Gander and Shanwick OCA's.

## So, What Are The Issues?

All Shanwick reported incidents have been analysed for the year 2010. This data set included reports received by the North Atlantic Central Monitoring Agency and NATS ATC Incident reports.

There were 19 reported Speed/ Time events over the calendar year 2010. (And in Jan 2011 (Until Jan19th) 3 reported events)




The three main types of speed/time based events reported were:

- Crew/ATC Domestic agency non adherence to Oceanic time restriction
- Crew non adherence to mach number issued
- Erroneous pilot estimate passed to ATC.

Within a procedural environment accuracy of ATC data is of paramount importance to enable the Oceanic controller to satisfy the prescribed separation minima.

Safety impacts of non adherence to Mach number, Incorrect Pilot estimate and failure to comply with ATC time restrictions can and sometimes do manifest themselves resulting in a reduction of safety margins and an increase in risk to the ATC operation.

ATC issues resulting from these events can include:

- The loss of separation
- ATC coordination errors based upon incorrect data
- ATC overdue action based upon incorrect time data, and
- Increased ATC workload issues such as non standard holding at the OCA boundary.

## How Do The Above Events Manifest Themselves Into Incidents?

### EXAMPLE 1 – Non adherence to ATC time restriction (22nd October 2010)

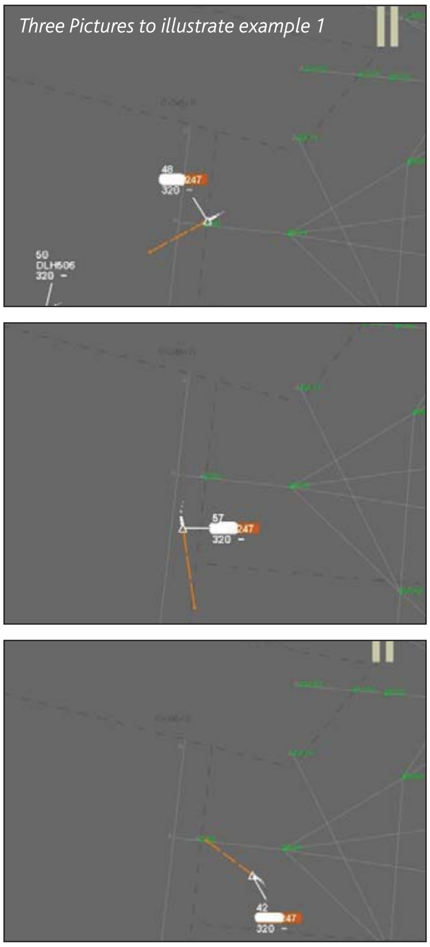
Flight 506 passed ETIKI at 22:30. Flight 247 had a Time Restriction of flight 506 + 10 minutes. Brest control issued a time restriction to flight 247 to cross ETIKI Not Before Time 22:40.

Brest phoned Shanwick Planner at 22:37:30 and advised that Flight 247 would not make the required time restriction. Brest suggested a 360 turn which was agreed by Shanwick. Due to the late coordination, Flight 247 was close to the Oceanic boundary, there was no possibility of preventing the flight from entering Oceanic airspace therefore a Loss of Separation was inevitable without corrective action.

Presented with an imminent Loss of Separation, and little time to consider options, the Ocean Planner agreed to Brest's suggestion of a 360 degree turn, which was the safest course of action.

It should be noted from the screenshots (The screenshots in this document have been provided by Brest Control, remember Shanwick does not have radar!) how big a radius of turn a B744 has, and what affect that would have had upon T9 and SEPAL traffic. Fortunately due to the time of day there was no traffic to effect.

*Three Pictures to illustrate example 1*



The next radar screen shot shows Flight 247 has infringed Shanwick airspace and is approximately 35 miles north of BREST Boundary point SEPAL.

Also of interest is the upper winds effect; with a stronger wind, the instruction for a 360 degree turn would have resulted in a greater radius of turn with Gross Navigational Error implications.

Late holding due to a failure to comply with an ATC time restriction at Oceanic Entry may result in an unplanned Oceanic airspace infringement, with re-entry at a position other than the intended boundary point This increases risk of a loss of separation at other entry points and Oceanic routings (such as Tango 9).

## EXAMPLE 2 – Crew non adherence to Mach number issued (Nov 10th 2010)

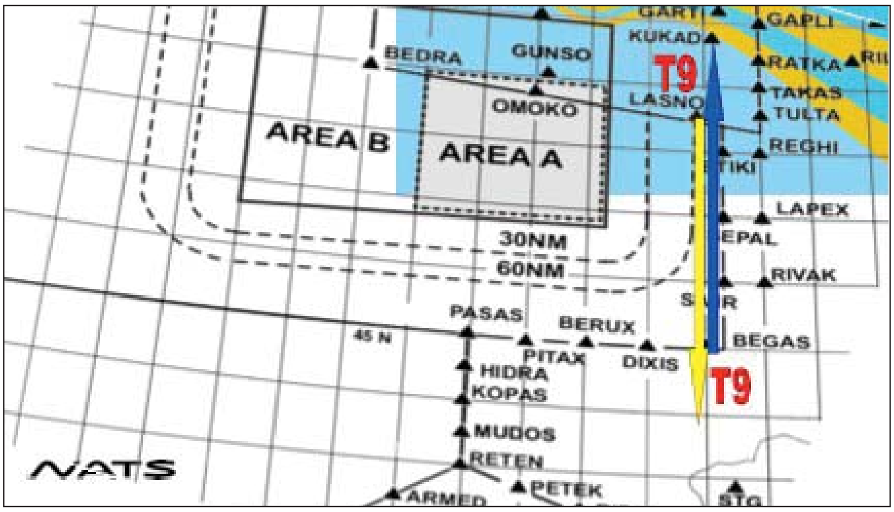
At 1845 'Flight A' made a position report stating that his estimate for 20W was time 1928, this was 7 minutes later than expected. Confirmation was sought from the flight and at 1848 a reply was received stating that the estimate was now 1929 and the flight requested a climb to FL370. The controller issued a further message asking the flight to confirm his speed. HF conditions were poor and it became difficult to contact the flight. At 1912 the flight confirmed that he was maintaining M076 in contravention of his clearance. The controller informed the flight of his cleared speed of M084, and at 1917 the flight confirmed he was increasing speed to M084.

Further investigations revealed that the crew recognized that they did not introduce the cleared Mach number (.84) into the FMC. The flight had been cleared at FL290 and there had been concern regarding fuel consumption at this level, however no request had been made for an amendment to the crossing speed.

Based on the fact that Procedural separations are time critical, non adherence to a cleared mach number must be advised to ATC at all times. This becomes increasingly more important with the introduction of Oceanic reduced longitudinal separations minima (RLONG).

## EXAMPLE 3 – Erroneous pilot estimate passed to ATC (November 17th 2010)

Oceanic clearances are based upon accurate times. Any time revisions of more than 2 minutes must be advised to ATC for onward coordination and separation purposes.




*Picture to illustrate example 3*

Flight Z requested Oceanic clearance along Tango 9 (T9) via LASNO (Oceanic Entry at Shannon boundary). The pilot estimate received was time 1314. A procedural clearance was issued to the flight based upon the time 1314. The actual estimate for LASNO was time 1245; 29 minutes difference. The incorrect time was picked up by Shannon radar and passed to Shanwick Oceanic. The Oceanic Planner then reissued an alternative clearance.
What are the safety implications of this incident? The safety net here was the Shannon domestic controller, should the controller have failed to check times an inadvertent infringement of Oceanic airspace within the procedurally complex Shanwick 'South East Corner' would have occurred. This would have been invisible to the Shanwick controller and had considerable safety implications.

Further investigations highlighted crew unfamiliarity with regards to Oceanic airspace, and knowledge as to where the Oceanic entry point was. Because of this the crew's estimate provided to ATC was for a different Entry point.

## Conclusions

Shanwick base their separations on a constant Mach (Mach number technique) and estimates to within+/- 2mins.

## Time Changes Are Important

**How can crews help?**

- Maintain the mach setting – if not advise Shanwick
- Know your Oceanic Entry Point
- Advise ATC of all known time changes + 2 minutes
- Advise ATC as soon as possible when you cannot comply with a time restriction.

If you have any queries on this or any other aspect of Oceanic Operations, please contact Gavin.Dixon@nats.co.uk

For further information on the SPA (Safety Partnership Agreement) please visit www.customer.nats.co.uk

# Falling Off The Mountain

**Determined but undisciplined captain, a meek first officer and a poorly flown approach: the ingredients for disaster, as Macarthur Job writes.**

After attempting to land from an excessively high and unstabilised approach at Mangalore, India, a Boeing 737 overran the runway, struck the ILS antenna structure, went through the airport fence, and fell 500 metres into a gorge. Fire broke out, eight passengers escaped through breaks in the fuselage, but the remaining 158 occupants died.

The Boeing 737-800, operated by Air India Express, was flying a daily return passenger service between Mangalore and Dubai. On 22 May 2010, after an uneventful flight from Mangalore, the aircraft left Dubai at 02.36 hours Indian standard time (IST). In command was a Serbian captain under contract to Air India Express. The other crew—first officer and four cabin crew—were Indian. There were 160 passengers on board, including four infants.

After a two and three quarter-hour flight at flight level 370, the aircraft contacted Mangalore Area Control at 05.47 IST. Fifteen minutes later it was cleared for descent to 7,000ft. Mangalore's area control radar was unserviceable and the Boeing was instructed to conduct an ILS DME arc approach for runway 24.

Mangalore Airport is built on a small, irregularly shaped plateau barely sufficient to accommodate its infrastructure. Its two intersecting runways are 102m above sea level, with the surrounding terrain falling away steeply on all sides. Because runway 24-06 is classified as a 'tabletop' runway, Air India Express requires that only pilots-in-command conduct take offs and landings there.

The Boeing's captain had landed there on 16 previous occasions. To the tower controller and others watching from the ground, including Air India Express staff awaiting the Boeing's arrival on the apron, the aircraft was excessively high and fast on approach, finally touching down much further along the runway than normal.

The thrust reversers deployed, but, still rolling fast, the aircraft overshot both the runway and the 60m overrun strip, before continuing at speed into the 90m safety area beyond. A further 85m on, the starboard wing struck the localiser antenna structure, tearing off the starboard engine and shearing the wing into pieces.

The aircraft broke through the airport boundary fence, then plunged into the steeply wooded gorge beyond it, where it broke into three, and caught fire. Eight passengers, suffering various degrees of injury, succeeded in escaping through breaks in the fuselage before the fire almost totally consumed the wreckage.

All the wreckage, including the damaged and fire-affected flight data recorder (FDR) and cockpit voice recorder (CVR), was recovered from the gorge and secured at the airport for detailed examination.

No evidence could be found of any defect or failure of the aircraft before the crash, nor of any bird strike.

The cockpit voice recorder had recorded the last two hours of the flight, and analysis ( by the US National Transportation Safety Board, because of fire damage to the recorders) of both the flight data recorder and CVR data allowed the circumstances of this period to be reconstructed in detail.

The aircraft, following its normal flight path between Dubai and Mangalore, had not encountered any turbulence, and for the first hour and 40 minutes, the only occasional cockpit communication was between first officer and cabin crew. There was no communication between the captain and the first officer. On the contrary, heavy breathing and snoring on the captain's CVR channel provided clear evidence that he was asleep in his seat.

The first officer meanwhile made all the radio calls, with no word from the captain concerning the weather or the aircraft's position. Moreover, when Mangalore Control told the aircraft to make a VOR DME approach for runway 24, only the first officer received this instruction. It was conveyed to the captain after he awoke, 21 minutes before the accident. There was thus a total breakdown in crew coordination and cockpit resource management.

At 05.42, the first officer gave the captain a short briefing on the weather and their expected approach to Mangalore—the first instance recorded on the CVR of any communication between the flight crew.

His briefing was inadequate, as was the captain's response, and certainly not in accordance with the airline's operating procedures.

Eight minutes later, Mangalore Control having cleared the aircraft down to 7,000ft, the first officer reported descending through FL295. Soon afterwards, when the Boeing was 50 DME from Mangalore, the captain deployed the air brakes to steepen their descent.

Much later than required, the pilots then carried out their descent preparation. According to the company operations manual, this preparation, intended to provide both pilots with a clear understanding of the plan for the descent, approach and landing, should be completed before the aircraft commences descent from cruising report level.

The company's operations manual also specifies that the crew's approach briefing, covering approach procedure, approach information, weather minimums, missed approach procedure, and landing and stopping distance planning, should be completed before beginning the instrument approach. There was no evidence that this was accomplished at all. Rather, when the first officer confirmed to the tower that the aircraft was on the VOR DME arc for runway 24 as instructed, and the tower requested them to when on the ILS, the only sounds heard from the captain for the following four minutes were of exhaling, yawning and throat clearing. Even so, at this stage the captain evidently realised that, despite the fact that the air brakes were deployed in the flight detent position, the aircraft was still too high on its approach. He therefore called for the undercarriage to be extended to increase the rate of descent.

Because the aircraft had been cleared to the ILS, a number of verifications specified in the operations manual should have been completed before it intercepted the localiser, and the flap selection should have been in accordance with the flap extension schedule.

Firstly, the captain should have prepared for interception by calling for 'flaps five' and, on the first movement of the localiser needle, the first officer should have called, 'localiser alive'. Instead, his call of 'VOR LOC captured', nearly a minute after the undercarriage had been lowered, was only after the aircraft had crossed the localiser, and then performed an S-turn to regain its extended centre line. This was a consequence of the aircraft's excessive speed, resulting from the fact that 'flaps 5' had not been selected.

Having captured the localiser at almost 10 DME, the captain requested 'flaps 10' while descending through 5,930ft at 202kt.

This of course was in excess of the 'flaps 10' extension speed, and the first officer responded questioningly, 'ten?' The captain then reduced speed appropriately.

At 7.6 DME, with the speed brakes still extended, and the aircraft fully established on the ILS, the captain was afflicted by a prolonged bout of coughing, after which he called for 'flaps 15' as aircraft was descending through 4,630ft at 6.7 DME.

By 4.3 DME, with the speed now 167kt at 3,465ft and 'flaps 25' selected, the air brakes were retracted. Half a minute later, at 3 DME, with the aircraft slowed to 159kt, the captain requested 'flaps 40', and the landing check list. Its challenges and responses were all called correctly without hesitation in clear voices. But soon after it was completed the first officer commented that the aircraft was too high and a moment or two later there was a 'twenty five hundred' announcement from the radio altimeter. A few seconds later, at 2 DME, the first officer, obviously concerned at the continuing high approach, called out, 'Runway straight down!' The captain's response was, 'Oh, my God!'

The captain, meanwhile, had redeployed the speed brakes to the flight detent position for more than half a minute to steepen the descent. This contravened the operations manual, which stipulates that when 'flaps 15' or more are extended, the speed brakes should be retracted. They should in any case be retracted before descending below 1000ft.

The captain now disengaged the autopilot to take manual control, and the first officer suggested in a questioning tone, 'Go around?' Three seconds later the captain exclaimed, 'Wrong localiser… glide path!' Evidently, because of the steepness of the approach, the aircraft's glide slope receiver had captured a false glide slope.

Despite the comments of the first officer that the aircraft was too high and that they should go around, and ground proximity warnings of 'Sink rate!' and 'Pull up!' that were now sounding in the cockpit, the captain persisted with his attempt to land. As the aircraft crossed the runway threshold, it was almost at 200ft and 164kt, in contrast to a normal Boeing 737 runway approach of 50ft and 144kt.

Because of the high speed, the aircraft's flap load relief system had moved the flaps back from their selected 40 degrees to 30 degrees, and when the speed reduced below 158kt, the flaps redeployed to 40 degrees. This flap extension during the flare close to the ground resulted in the aircraft floating and a late touchdown. The starboard wheels touched first, 4,500ft down the runway, but the aircraft bounced slightly, finally landing 5,200ft from the threshold.

The captain selected reverse thrust and began braking, but fearing the aircraft would not stop in time, and despite clear instructions in the operations manual that thrust reverse should not be cancelled to begin another take-off, he stowed the thrust reversers and applied full power to go around.

This was the final link in a chain of operations manual violations that led to the accident. It was established during the investigation that if the captain had deployed detent reverse thrust and applied maximum braking on touchdown, the aircraft could have been brought to a stop, if not 7,600ft from the threshold of Mangalore's 8,033ft runway as theoretically possible, then at least on the cleared overshoot area beyond it, and there would have been no accident.

Apart from the captain's numerous procedural violations during the approach, cultural factors played a role in the development of this accident. The captain and first officer did not communicate adequately with each other.

When the captain continued the approach in an unstabilised condition, despite the fact that it was not in accordance with standard procedures, and then failed to take corrective action, the first officer did not assert himself.

There is an optimum 'trans-cockpit authority gradient' for effective crew performance. The gradient in this case was steep because the captain was assertive and the first officer submissive, resulting in a chain of errors that went uncorrected. When the first officer tried to help the captain see the need to go around, the captain disregarded his advice.

## Cause

The inquiry determined that its cause was the captain's failure to discontinue the unstabilised approach and his persistence in continuing with the landing, despite three calls from the first officer to go around, and a number of warnings from the ground proximity warning system.

## Comment

This accident could almost be the Garuda Indonesia crash at Jogjakarta, on 7 March 2007, all over again. Among the 21 killed and 12 seriously injured in that accident were five Australians.

In both crashes the captain's actions were incomprehensible. The profession of airline captaincy is not simply the ability to fly and command a large aeroplane with skill—it also requires self discipline as a way of life, an ongoing resolve to operate at all times and in all circumstances within defined parameters of safety.

The Indian first officer first flew a Boeing 737 straight out of flying school with only 300 hours. By the time of the crash he had accumulated around 3,200 hours, having gained almost 3,000 hours as a co-pilot on the B737. Listing the contributing factors to the accident, the investigation cited that although the first officer made repeated calls to the captain to go around, he did not take over the controls to discontinue the ill-fated approach. It suggested his reason for not doing so was that company instructions empowering a first officer to initiate a go-around when danger threatened were ambiguous.

Yet the report gives no hint as to how he could have wrested control from a captain fixated on landing. Did the investigation really expect such a captain to quietly hand over control? But if the first officer had been trained to call for a go-around while simultaneously retracting the undercarriage, the outcome could hardly have been worse for him than meekly accepting his impending doom.

***Reprinted with kind acknowledgement to Flight Safety Australia & Macarthur Job.***

# Identifying the Problem – Understanding the human factor

by David Olsen

*AMOs work in a hazardous environment and are just as much – or more – at risk from Human Factor conditions as the flight crew.*

**The human element is the most flexible, valuable and adaptable part of the aviation system. Such is the description found in CAP 716 created by the U.K.'s Civil Aviation Authority – the governing body that ensures civil aviation standards are set and achieved. And so if this statement is indeed accurate, it begs the question of why, statistically, have three out of every four accidents resulted from degraded or below optimum human performance?.**

Degraded performance can occur anywhere – on the ground or in the air, by anyone involved in the aviation system.

This is the Human Factors (HF) variable, a key element in aviation safety defined by the International Civil Aviation Organization (ICAO) as being "about people in their working and living environments and their relationship with equipment, procedures and the environment. Just as importantly it is about their relationships with other people."

Transport Canada (TC) did valuable work on human performance in 1999, introducing HF requirements in CARs for AMOs, airport personnel and Flight Service Specialists (FSS). Transport Canada was very specific about HF training for AMOs; not surprising, since Dr. Bill Johnson, Federal Aviation Administration (FAA) Chief Scientific and Technical Advisor for HF in Aircraft Maintenance Systems, confirmed that approximately 80 per cent of maintenance mistakes involve human errors. TC mandated two days of initial HF training for AMOs (Airworthiness Directive B058 4th Ed 2005) but this was subsequently cancelled, a decision QualaTech-Aero Consulting president Keith Green maintains has caused the HF program to stagnate or degrade. QualaTech is an international consultancy group based in Canada that has presented many HF training courses since 2002.

"Some aviation managements are not getting the big picture, in which HF and SMS are key tools to prevent error and financial loss," says Green. Many view HF training as a cost rather than an investment, he adds.

Gail Vent shares a similar perspective. The training director of the Canadian Council for Aviation and Aerospace (CCAA) reminds us that the CCAA recognized the importance of HF in the late '90s, and developed a national two-day human factors certificate course that is TC compliant and includes all aspects of HF and safety management. Vent describes the CCAA's Human Factors and Safety Management Program as "providing the aviation industry with the information, tools, and training to implement continuing long-term safety programs and procedures which develop and maintain effective human-centered safety management skills and programs." More than 3,500 people have taken the HF course since 2003 whereas the Human Performance in Aviation Maintenance online training has, since 2004, been taken by more than 5,300 people.

Australian safety researcher Allan Hobbs confirms that QualaTech and CCAA's concerns are well founded. Says Hobbs: "AMOs work in a hazardous environment that requires physical strength, meticulous attention to detail [and they] may work deep in some confined inner space in extremes of heat and cold and at night." In today's stressful world, management and regulators must consider the outcome of employees who may be under marital stress, living in high cost areas, are having trouble paying a mortgage, and are sleeping badly as a result. All of these situations may be distracting them at work, resulting in a lack of teamwork compounded by a lack of knowledge and training. The end result may be a wide-body jet plunging earthward with 300 people facing oblivion.

## There are few true "accidents"

The only true accident is the one that cannot be foreseen, but "accident" is used daily in aviation when it is obvious that most so-called accidents are not true accidents at all. Most are attributed to human error or degraded performance. This demonstrates that we are quick to pass judgment on where and how in the aviation system human failure occurs and have not mastered the art of getting to the "why." People affected may also suspect that "human error" may be a convenient way of passing blame down to scapegoats at a lower level or those who are dead.

For example, after the widely reported case of the air traffic controller falling asleep on the night shift at Washington National Airport on March 23, U.S. FAA administrator Randy Babbitt replied: "As a former airline pilot, I am personally outraged this controller did not meet his responsibility to help land these two airplanes."

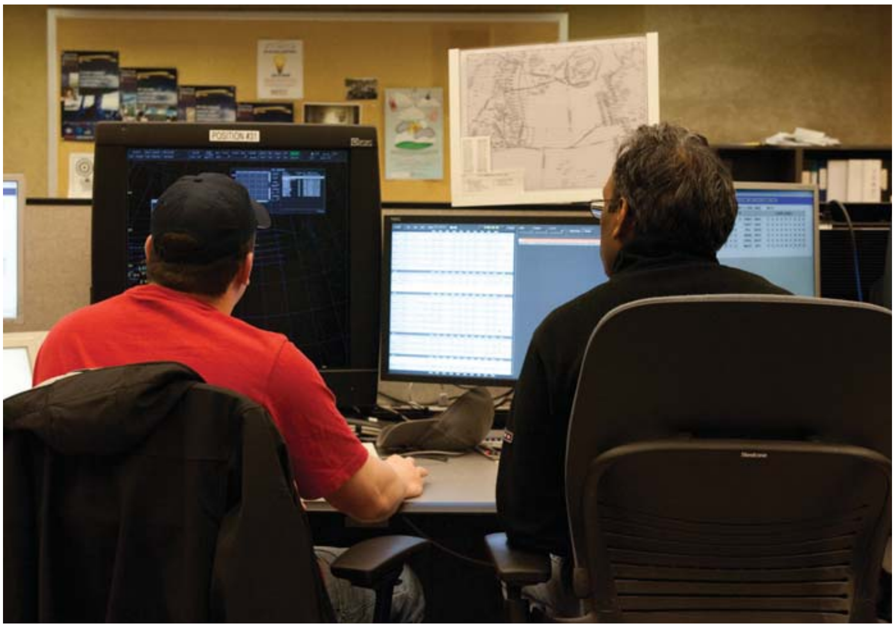
A U.S. Republican congressman demanded that the FAA "make an example" of the hapless controller. Stirring words indeed, followed by the suspension of the controller and enforced resignation of the head of U.S. Air Traffic Control.

Given that Babbitt immediately increased night time staffing levels and ordered a major system review, cynics might ask why he didn't initiate these measures sooner and discover why controllers fall asleep.

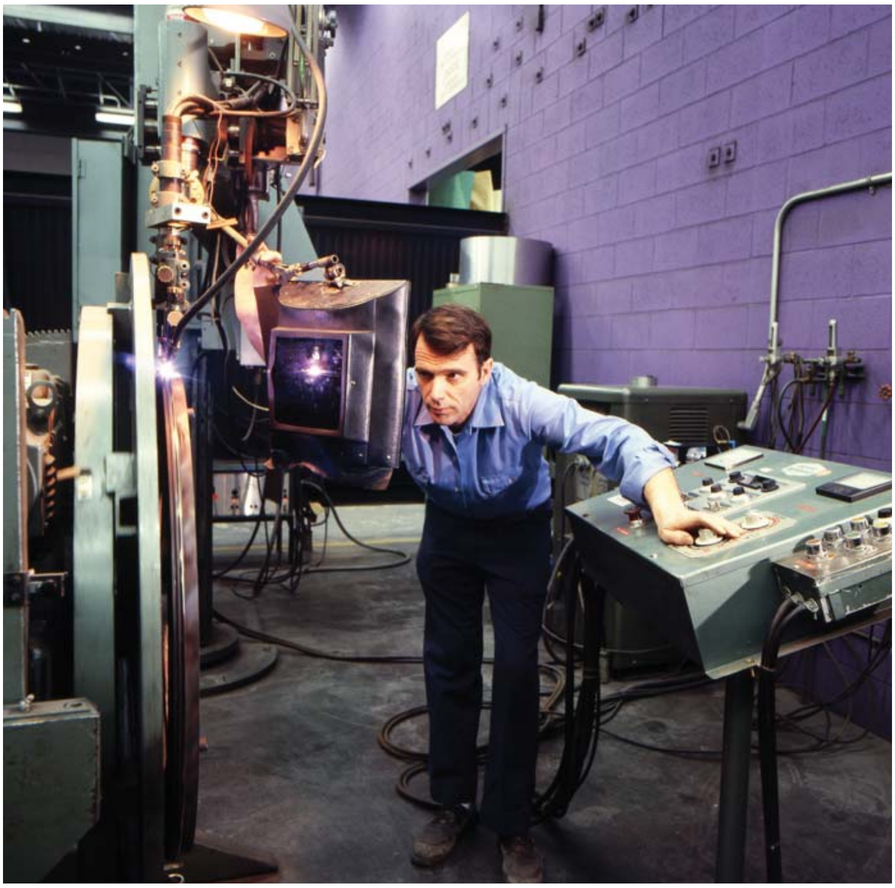
They might also ask why controllers, as reported, take naps while on shift.

**The end result maybe a wide-body jet plunging earthward with 300 people facing oblivion.**

While the FAA has been in the news, NAV CANADA has consistently addressed HF with a robust program directed by John David, VP Safety and Quality. David stresses that Human Factors is one of 16 Safety Management Policies forming the core of NAV CANADA's Safety Management System (SMS). The Policy integrates HF into all activities affecting provision of air navigation services. "The objective," says David, "is to include HF in the safety and risk management policies, practices and procedures, and to systematically apply HF



*Human Factor elements are felt at every level of the aviation spectrum – from air traffic controllers to AMEs. Here, an on-the-job controller trainee in Gander, Nfld., learns his craft.*



*Human Factor elements such as distractions at work or poor sleeping habits can seriously affect job performance – and hinder the safety environment. AMOs are particularly at risk.*

in management activity, including the planning, design, development, deployment, operation and maintenance associated with NAV CANADA services."

"HF underpins all elements of the company SMS," David says. "For example, we use it to investigate aviation incidents, to understand the reason why the event occurred, focusing on identifying organization, local workplace conditions, or changes in the operating environment that may have played a role." Controllers and FSS are introduced to the basic HF concepts early in training, and annual recurrent training contains HF topics, such as Just Culture, Threat and Error Management, Fatigue Management, and, most recently, the Human Factors of Automation in Air Traffic Management. It also provides the view from the pilot's world through an overview of HF and Automation in the Cockpit.

## Under the microscope

The HF issue of fatigue captured public interest after the high-profile Feb. 12, 2009, Colgan Air crash at Buffalo. Media coverage in the U.S. and Canada pointed to pilot fatigue. But fatigue, while deadly, is just one of the widely recognized "dirty dozen" human factors. Furthermore, HF affects everyone in aviation – flight crew, maintenance engineers, designers, airport staff and AT controllers – throughout the system. It can even include passengers – for example, the intoxicated passenger who caused the fatal crash of a floatplane on the B.C. coast in 2010. The November/ December 2010 issue of Wings also highlighted the case of the fatal crash of the MK Airlines Boeing 747 at Halifax in 2004, in which crew fatigue was cited as a major causal factor. Taking the total HF view, however, there was more to it than just fatigue. In this and other incidents, the question remains: why are people fatigued and what were the other HF pressures?

The answer can be found in an analysis of the Pandora's Box of human factors (the "dirty dozen") and how they interact. The "dirty dozen":

- Lack of Communication
- Lack of Knowledge
- Lack of Teamwork
- Lack of Resources
- Lack of Assertiveness
- Lack of Awareness
- Complacency
- Distraction
- Fatigue
- Pressure
- Stress
- Norms

The Colgan crash bears scrutiny in terms of the "dirty dozen." The NTSB report illustrates that as many as nine were involved and this was only at the flight crew level. Those factors were interacting and some must also have been in-play at other levels in the company organization.

If crew members lack knowledge or are under stress – and fatigued – who else may have caused that situation? What human factors were affecting them?

## Approximately 80 per cent of maintenance mistakes involves human errors

This problem is by no means new, but after an accident, authorities continue to close the stable door after the horse has bolted. The U.S. National Transport Safety Board (NTSB) chair praised the FAA administrator for initiating regulatory changes in response to the Colgan Air crash and regulators worldwide often propose changes after a problem has killed people. We are transfixed by the "how and what" but are not proactive enough about the "why."

So, how do we learn from these events? Often it seems, it's too little, too late – as grieving relatives complain. There are certain eerie similarities between the Colgan Air crash and the loss of Air France 447 over the South Atlantic in 2009. In particular, both aircraft stalled, and, in neither case did the pilot(s) level the attitude – the planes remained nose up with high angles of attack. These incidents have generated a huge debate about pilot training, flight deck automation and stall recovery techniques for new-generation aircraft.

At the Flight Safety Foundation safety seminar in Milan last November, FAA HF specialist Dr. Kathy Abbott presented evidence of "disharmony between crews and their automated aircraft." Unfortunately, as with fatigue, the aviation industry has perhaps had a historical tendency to underestimate the effect of the "dirty dozen" and overestimate the

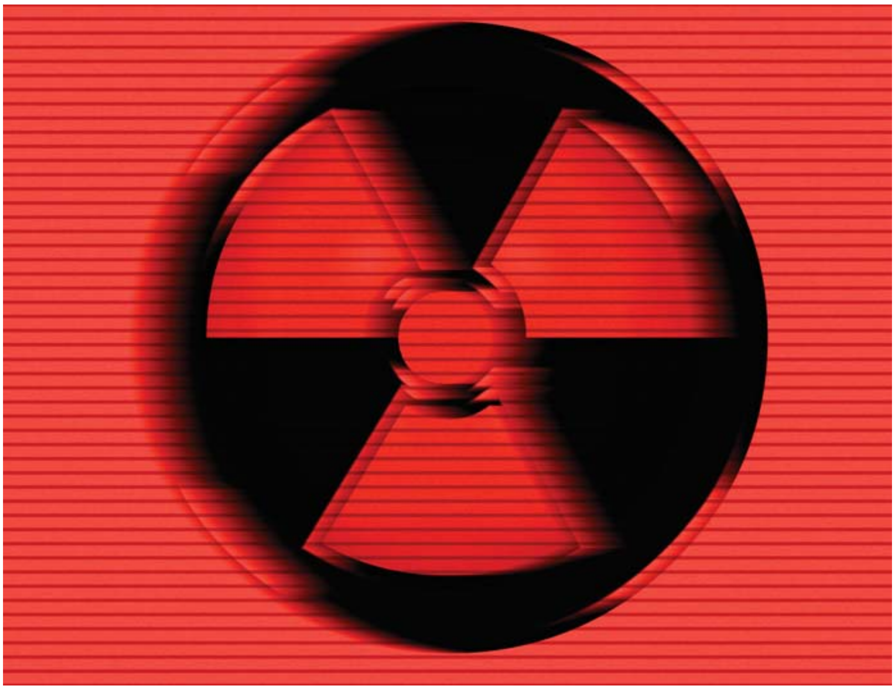
*John David, VP, Safety and Quality, at Nav Canada, says driving home the Human Factor principles to upper management at various organizations remains a top priority.*

human capability to cope with them. So, it remains to be seen if anyone will act on the "disharmony." And in case we think we have fixed the problems, consider this: since 2000, some 9,000 people have been killed in more than 340 global airline accidents. And industry observers are concerned that safety improvement has stagnated.

***As appeared in Wings Magazine.***

# Putting us in the picture

Doctor Sheila Stork explores the general principles of radiation.



**TRANSEC's (Transport Security) decision to introduce backscatter scanners at passenger security points has undoubtedly generated some concern amongst pilots. This article on radiation aims to provide a general introduction to some basic aspects of radiation.**

## Classification of radiation

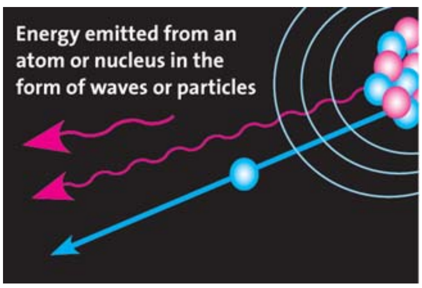
Radiation is simply the transfer of energy from one source to another. It can be classified as either ionising or non-ionising.

Ionising radiation is radiation with enough energy so that during an interaction with an atom, it can remove tightly-bound electrons from the orbit of an atom, causing the atom to become charged or ionised.

This type of radiation may be made of particles (such as alpha particles, beta particles, or neutrons) or energy waves (such as x-rays or gamma rays).
Particulate radiation consists of atomic or subatomic particles (electrons, protons, neutrons), which carry energy in the form of kinetic energy or mass in motion. Alpha particles and beta particles are considered directly ionising because they carry a charge and can, therefore, interact directly with atomic electrons. The neutron is an indirectly ionising particle as it does not carry an electrical charge. Ionisation is caused by charged particles, which are produced during collisions with atomic nuclei.

Electromagnetic radiation is energy which is carried by oscillating electrical and magnetic fields travelling through space at the speed of light. The high frequency part of the electromagnetic spectrum consists of ionising radiations such as gamma and x-rays, which are indirectly ionising radiation.

However, not all electromagnetic radiation is ionising. The low frequency range of the electromagnetic spectrum (including radio waves, microwaves infrared, visible and ultraviolet light) have less energy than the higher frequency end of the spectrum and are unable to interfere with atomic bonds.




These types of radiation are referred to as non-ionising radiation.

## Units

There are a number of units currently used to describe radiation doses.

Radiation dose can be described as the amount of energy absorbed by the body per unit mass (1 joule per kilogram = 1 Gray). Probably the most useful is the 'effective dose', which is measured in Sieverts (Sv). This unit takes into account the amount of energy absorbed, which is then weighted to take account of the specific type of radiation and the different radiation sensitivities of human tissues. As radiation doses are typically very small, the millisievert (1 x 10-3 Sv) or microsievert (1x 10-6 Sv) are commonly used.

## Ionising radiation in our environment

Radiation has always been a natural part of our environment and is derived from a combination of terrestrial, cosmic and man-made sources. Natural radioactive sources in the soil, water and air contribute to our exposure to ionising radiation, as well as man-made sources resulting from mining and use of naturally radioactive materials in power generation, nuclear medicine, consumer products, military and industrial applications. Cosmic radiation consists of galactic radiation (from exploding stars) and solar radiation (from explosions on the sun's surface). At ground level, the combined dose from all terrestrial and cosmic radiation sources is approximately 0.8 to 0.12 microsieverts per hour. Cosmic radiation increases with both latitude and altitude, therefore higher levels are experienced in flight – approximately 5 microsieverts per hour.

Each member of the world population is exposed, on average, to 2.4 millisieverts per year from natural sources. In some parts of the world the natural radiation dose may be five to 10 times higher than this level. The normal environmental dose in the UK is 2.7 millisieverts, with higher doses seen in areas with radon gas emitted by uranium decay in granite, such as Cornwall or Derbyshire.

## Health effects of radiation

Humans have evolved within a radiation environment and ionising radiations are amongst the most studied human toxins. Naturally occurring radionuclides in the earth's crust have been decaying since the earth was created and current background radiation levels are therefore lower than they were in the past.

All human body cells are therefore continuously subjected to some degree of radiation damage and have subsequently developed efficient and sophisticated cellular repair mechanisms to repair such damage.

Adverse health effects arise only when these repair mechanisms fail. The resulting radiation effects are termed 'somatic' if seen in the irradiated individual and 'hereditary' if manifest in their offspring. Somatic effects may be further categorised as either stochastic or non-stochastic.

Stochastic effects are 'all or none' where the frequency of an effect varies with dose. The cancer from a large radiation dose is the same as the cancer caused by a small dose – but the cancer will be seen far less frequently with the small dose. It is assumed that there is no threshold below which stochastic effects do not occur.

Non-stochastic (or deterministic) effects are where the severity of the effect varies with dose. There is evidence for a clear threshold, below which the effect does not occur, although with some degree of variation in individual sensitivity. Skin burns and cataracts are deterministic effects.

*"Most pilots receive an occupational exposure in the order of 3 to 5 millisieverts per year, which is around one quarter of the ICRP implied annual dose limit."*

The International Commission on Radiation Protection (ICRP) recommend dose limits which aim to prevent nonstochastic and limit stochastic health effects. In the early 1990s, the ICRP considered aircrew to be occupationally exposed to ionising radiation. Pilots differ from the 'classified' radiation workers (such as those in the nuclear industry, or medical and industrial radiology) as their radiation exposure is predictable and calculable, and because they do not work with radiation sources they are not at risk of accidental excess exposure.

The ICRP limits occupational exposure to 100 millisieverts over five years, which implies an annual dose of 20 millisieverts per year. Additional restrictions apply in pregnancy and workers under the age of 18. The ICRP limits are for occupational radiation exposure and are in addition to the non-occupational background radiation exposure. Most airline pilots currently receive an occupational exposure in the order of 3 to 5 millisieverts per year, which is around one quarter of the ICRP implied annual dose limit.

Airline requirements are set out in EUOPS 1.390:

(a) An operator shall take account of the in-flight exposure to cosmic radiation of all crew members while on duty (including positioning) and shall take the following measures for those crew liable to be subject to exposure to more than 1 millisievert per year:

(1) Assess their exposure;

(2) Take into account the assessed exposure when organising working schedules with a view to reduce the doses of highly exposed crew members;

(3) Inform the crew members concerned of the health risks their work involves;

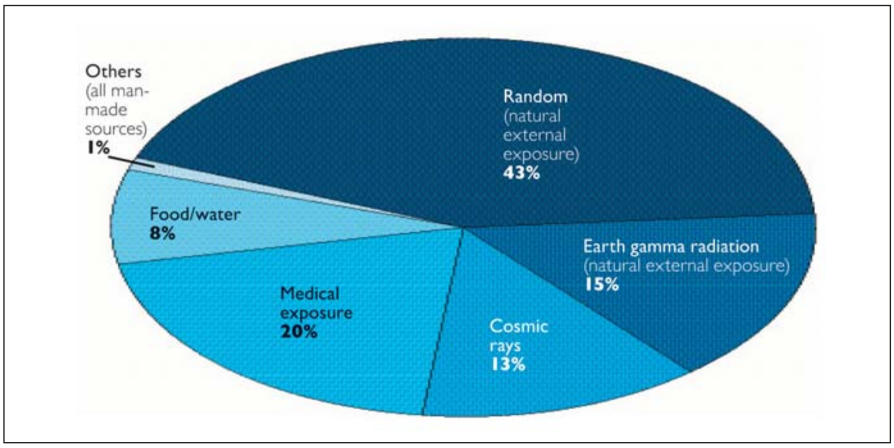
(4) Ensure that the working schedules for female crew members, once they have notified the operator that they are pregnant, keep the equivalent dose to the foetus as low as can reasonably be achieved and in any case ensure

that the dose does not exceed 1 millisievert for the remainder of the pregnancy;

(5) Ensure that individual records are kept for those crew members who are liable to high exposure. These exposures are to be notified to the individual on an annual basis, and also upon leaving the operator.

Many UK airlines determine exposure with the CARI-6 program developed by the FAA. This program calculates the effective dose when flying between two cities, taking into account route, altitude and variations in the earth's magnetic field and solar activity.

Further information can be found at http://www.faa.gov/data_research/research/med_humanfacs/aeromedical/radiobiology/cari6/




*WHO sources and distribution of average radiation exposure to the world population*

**Sources:**

Oxford Handbook of Occupational Health 2010
WHO document – Ionising radiation
Radiation and Reason(2009) – Wade Allison.

## BACKSCATTER SCREENING STATEMENT BY BALPA MEDICAL STUDY GROUP

For BALPA to persuade the DfT (Department for Transport) that pilots should be permitted to opt out of backscatter screening then our interpretation of the radiation health risks must be sensible, scientific and factual.

The bottom line is that backscatter scanners involve an extremely low dose of ionising radiation. A number of respected independent bodies have reiterated that there is no significant risk to health from this level of radiation, including the American College of Radiology, the Health Physics Society, the US-ALPA Aeromedical Group, and the UK Health Protection Agency.

As flight crew, the worst-case scenario (calculated 500 backscatter examinations per year) would result in an increase in radiation exposure in the order of approx one per cent per annum. When combined with inflight radiation exposure, levels still remain well below the annual limits for workers occupationally exposed to radiation.

BALPA's Medical Study Group believes that there are two reasons why BALPA should be opposed to the use of backscatter scanners, based on the well-established International Commission on Radiological Protection (ICRP) principles of Justification and Optimisation:

1. Justification: If there is no 'safe' radiation dose, then any use of radiation must be justified, e.g. use of radiation in medical imaging and smoke detectors is considered a greater benefit than risk. In the case of backscatter scanners, the DfT justifies their use in detecting prohibited items concealed on passengers as a net benefit to society when compared with the potential risks associated with ionising radiation. Currently, the DfT makes no distinction between pilots and passengers, but the threat posed by pilots is not the same as the threat posed by passengers.

Therefore the justification for passengers should not be applied to pilots.

2. Optimisation: radiation risks should be assessed and reduced wherever possible. This principle is known as 'as low as reasonably achievable' (ALARA) or 'as low as reasonably practicable' (ALARP). This process takes into account both social and economic factors. There is legal precedent for the ALARA principle to take priority even when doses are well below exposure limits. In keeping with this principle, pilots should be permitted to opt out of backscatter screening.

Backscatter radiation exposure whilst on duty should be classed as occupational exposure and should therefore be included in the airline's assessment of occupational exposure under EU Ops 1.390.

The Medical Study Group continues to monitor and consider any further information and developments on this issue.

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# A Pilots Guide to operating Outside Controlled Airspace in the UK

**Most commercial flights are operated within controlled airspace, but from time to time it may be necessary to operate outside controlled airspace. The following are examples:**

- Routes outside controlled airspace
- Airfields outside controlled airspace
- Off airways arrivals and departures
- Approaches partly outside controlled airspace
- Weather deviations outside the airway

Aircraft outside of controlled airspace are not required to be in contact with ATC. Traffic separation outside controlled airspace thus becomes the pilots' responsibility. Assistance is often available from ATC, yet they can only provide separation from aircraft known to them or which appear on radar. It is important to note outside controlled airspace it is for the pilot to choose the desired level of service from ATC and to request it (the types of service available are listed at the end of this guide). If ATC are unable to provide a level of service they will advise the pilot and may offer an alternative. Each type of service forms a working agreement between the controller and the pilot. Irrespective of the service type in place, looking out of the window remains essential.

## See and Avoid

See and avoid is recognised as one important way in which pilots can seek to minimise the risk of collision when flying in VMC and in particular when operating in Classes D, E, F and G airspace. Whilst pilots who operate regularly in uncontrolled airspace are aware of the need for good lookout, those who do not may need to make a conscious effort to change their normal flight-deck management to include effective see and avoid techniques. To assist other aircraft in seeing you, it's a good idea to turn on available lighting, for instance the landing lights. Whilst effective employment of see and avoid techniques undoubtedly prevents many collisions, it cannot necessarily be relied upon and is only one of a number of collision counter measures including the use of a radar service and an Airborne Collision Avoidance System (ACAS), such as TCAS. To aid the above, it is recommended pilots limit speed as much as practicable.

## Visual Scan

It is important to adopt a frequent traffic scan that accounts for factors such as field of vision, ambient light levels, motion, distractions etc thereby improving the visual detection rate. Effective scanning is accomplished by a series of short, regularly spaced eye movements that bring successive areas of the sky into the central visual field. Each area should be observed for at least one second to enable detection. Each time a scan is stopped and the eyes are refocused, peripheral vision takes on more importance because it is through this area that the presence of other aircraft is often detected. It is important to remember that if another aircraft appears to have no relative motion in the windscreen it is likely to be on a collision course hence the importance of keeping head and eyes moving during an effective scan.

## ATC Service Principles Outside Controlled Airspace

In uncontrolled airspace the pilot is ultimately responsible for terrain and obstacle avoidance although ATC may assist them. A core element of the procedures is the principle of Pilot/Controller agreement which may restrict aircraft to a particular level or band or heading or area. Once a pilot has acknowledged a particular type of service there is assumed to be an 'accord' between pilot and controller. If a pilot subsequently requires a different service a new 'accord' shall be negotiated. Controllers will not provide elements of a higher level of service unless a new 'accord' is agreed. Although controllers will endeavour to pass timely traffic information there may be occasions due to workload or equipment limitations when this is not possible. In this case the controller will inform the pilot of the downgrade to the ATC service.

## Operation below ATC Terrain Safe Levels

A pilot receiving an ATC Service may request or be given a heading or descent such that it will bring the aircraft below the ATC unit terrain safe level. The controller will remind the pilot that they remain responsible for terrain clearance, and the pilot must acknowledge this using the words 'Own Terrain Clearance'. In aircraft equipped with EGPWS it is a good idea to have terrain displayed.

## Speed Control

A maximum speed of 250kt below 10,000 feet is mandatory during flight outside controlled airspace in the UK and slower speeds assist in seeing and avoiding other traffic.

## Types of ATC Service

- Deconfliction Service - This provides the pilot with traffic information and deconfliction advice on conflicting aircraft. Headings and levels may be issued by the controller for deconfliction but avoidance of other aircraft remains the pilot's ultimate responsibility. ATC will expect the pilot to accept headings and levels that may require flight in IMC and they may request turns or squawk changes to identify a particular aircraft. Controllers will pass traffic information on conflicting traffic and advice to avoid. A pilot may elect to ignore such deconfliction advice but he must inform ATC and then accept responsibility for avoiding action. When under a Deconfliction Service pilots may not change heading or level without first obtaining a response from the controller unless safety is likely to be compromised. A Deconfliction Service is only provided above an ATC unit's safe terrain level (above Minimum Flight Altitude) unless an aircraft is departing an aerodrome (and climbing to a safe level) or following an instrument approach procedure. **Radio Procedure:** *'Request Deconfliction Service'.*

- Procedural Service - This is a non-radar service in which separation is provided between those IFR aircraft that are participating in an ATC Service and traffic information may be provided on known VFR aircraft. ATC will pass instructions which if followed will achieve deconfliction against other aircraft in receipt of a service from the same controller. Avoidance of traffic remains the pilot's responsibility. Deconfliction or traffic information will not be passed on aircraft that are not in receipt of an ATC service. Controllers will expect pilots to accept instructions (tracks/radials or levels/level bands) that may require flight in IMC. Pilot's shall not change a level or track without obtaining approval from the controller as other aircraft may be coordinated by ATC. The pilot remains responsible for terrain avoidance. **Radio Procedure:** *'Request Deconfliction Service'.*

- Traffic Service - Pilots will be passed traffic information on conflicting aircraft. No deconfliction advice will be offered however, and the pilot remains responsible for collision and terrain avoidance. ATC may however offer headings or levels for positioning/ sequencing/navigation. Again this service is not appropriate for flight in IMC. If given a heading or level a pilot should not alter course or change level without first advising and obtaining a response from the controller. **Radio Procedure:** *'Request Deconfliction Service'.*

- Basic Service - Avoidance of other traffic and terrain is solely the pilot's responsibility. This service is not appropriate for flight in IMC. Note: ATC radar is not required to provide this service and it may be provided by a lower grade of controller (FISO). **Radio Procedure:** *'Request Deconfliction Service'.*

# Distress and Diversion Flight LATCC(Mil)

by Flight Lieutenant Martin Smith, Officer Commanding Distress & Diversion

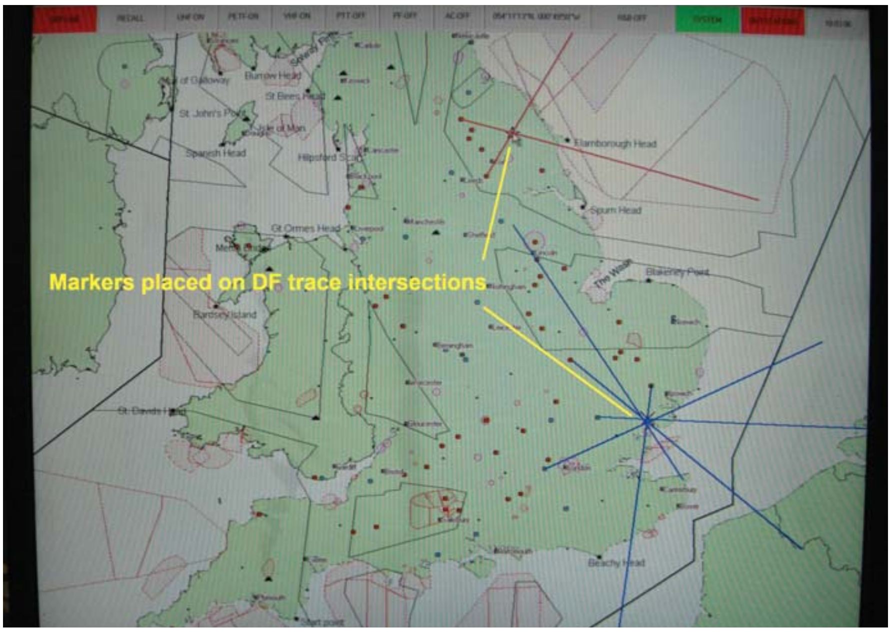
**MAYDAY! MAYDAY! MAYDAY! Three little words guaranteed to grab the attention of any Air Traffic Controller. For the listener, the physiological effects are immediate; raised temperature, increased heart-rate, adrenaline levels rising and muscles tensing. If this is what it feels like to hear a MAYDAY call, imagine for a moment what it must feel like to have to transmit that message.**

In the LATCC(Mil) Distress and Diversion (D&D) section at Swanwick, those words were heard on no less than 64 occasions during 2010. As guardians of the London FIR emergency frequencies 243.0MHz and 121.5MHz, the Royal Air Force staff in D&D are well-versed in assisting all pilots, military and civil, facing imminent and potentially life-threatening danger. A calm and professional response can provide the most comforting reassurance that someone is out there who can help.

The role of a D&D controller is quite simple – to provide an immediate response to any aircraft that requires assistance. It is a service that covers an infinite number of possibilities and options. It could be an aircraft suffering from mechanical failure, a fuel-leak, unruly passengers, a bird-strike, a laser shone at the cockpit...the list is quite literally endless; anything and everything that flies is subject to a high potential of injury or fatality when something goes wrong or the unexpected occurs. It is the role of the D&D controller to provide the highest level of assistance, as quickly as possible, to give the aircrew the best possible chance of making a safe recovery to a suitable landing site.

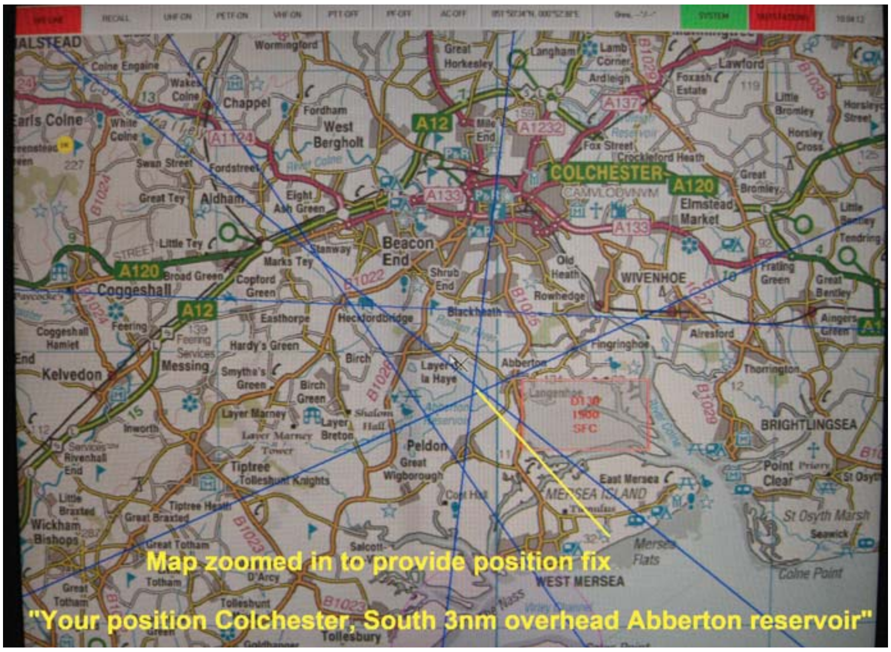
## Emergency Types

Each and every emergency is different; the type of aircraft, the altitude, the speed, the kind of emergency, the airspace involved and the meteorological conditions are just some of the considerations. The one constant in every emergency is how D&D responds. In every case, the first transmitted response will be "Callsign, London Centre, PAN/MAYDAY roger, squawk emergency, pass details when ready". We aim to do this within 3-5 seconds of receiving the emergency call. As soon as a pilot knows that someone has heard the PAN or MAYDAY call, this small amount of reassurance can have an immediate beneficial effect.




Whenever a radio call is made on 243.0 or 121.5MHz in the London FIR, the D&D controller can identify exactly where the transmission originates using a range of very capable equipment. Throughout the UK, a series of Direction-Finding (DF) transmitters and receivers provide the bearing of the call and the correlation of these bearings provides a instantaneous position fix for the D&D controller overlaid on a map of the UK, a system collectively termed Auto-Triangulation (Auto-T) (see pic 1). Unless the transmission is at very low altitude (>1500ft amsl), the Auto-T will give an exact and accurate position of any transmission on the emergency frequencies. Supporting this, D&D has access to radar surveillance covering the whole of the UK provided by multiple, integrated, NATS radar sources (see pic 2). This system also provides immediate recognition, with an alarm function, of any emergency squawk and facilitates the provision of a radar service by the D&D controller in all airspace environments. It is also possible to combine both radar and Auto-T with OS mapping capabilities, enabling a D&D controller to provide a radar service to an aircraft whilst simultaneously passing information on distinctive ground features to help the pilot orientate himself to what he can see from the cockpit.

The Auto-T mapping includes every major and minor aerodrome in the UK. In addition, it also includes every registered airstrip and usable




landing ground together with runway directions and lengths, airfield details and can be zoomed in to Ordnance Survey street level detail. This enables the controller to provide the optimum landing options to a pilot in distress for his given aircraft type.

All of this information has to be assimilated by the controller within the first few seconds of an emergency call. On hearing the MAYDAY or PAN, the controller quickly marks the exact location of the transmission on Auto-T and zooms in the map. Simultaneously, the radar map is correlated to the exact location and the radar return is highlighted. The controller can make a quick estimation of the nearest suitable aerodrome capable of recovering the aircraft safely and provide a steer for the pilot. This process takes around 5 seconds. The time waiting for the pilot's response can vary but is generally short. In every emergency, D&D alerts the Aeronautical Rescue Coordination Cell (ARCC) currently based at RAF Kinloss and passes brief details, which allows the ARCC to begin the process of activating an immediate Search and Rescue (SAR) response if considered appropriate.

### The Next Steps

The actions that follow will depend upon the response of the pilot. If a recovery to an airfield is required, the D&D controller can continue providing vectors to the nearest suitable aerodrome or landing site (see Pic 3). It may be the case that the pilot wishes to descend immediately or climb to higher altitude, or to transit to a specific area (away from turbulence for example). The possibilities are endless and the D&D controller has to be ready for anything.

Throughout an emergency situation, the D&D controller will provide as much assistance as required and will aim to facilitate the pilot's requirements wherever possible. That may be navigational assistance, communicating with engineers for advice, alerting interested parties or just providing a simple radar service en-route. In all cases, the D&D controller will endeavour to ensure that the pilot receives the optimum service to enable a safe recovery. When diverting to an established aerodrome, it will normally involve handing the emergency over


*Up Close*

to a controller at the unit, as they will know their own airspace better and are invariably better equipped to provide a service at lower levels. In all cases, D&D will continue to track the progress of the aircraft until the conclusion of the emergency which is hopefully (and most commonly!) a safe landing.

In addition to helping pilots during an emergency, the staff of D&D also carry out a number of other tasks: tracing lost or overdue aircraft, monitoring special flights (VIP), reporting laser attacks on aircraft and a host of other special tasks. For all tasks, the D&D controller requires a huge amount of background knowledge on many airspace and aviation issues and we are fortunate to have access to a wide range of information systems that help with the tasks. The majority of D&D staff are from experienced backgrounds and have developed a keen information-sharing ethos which is encouraged throughout the team.

## Practice

Controller training is carried out using simulators and during real-time scenarios involving practice emergencies. Military pilots have the benefit of using a dedicated practice emergency frequency (UHF). We encourage the use of the VHF emergency frequency during quiet periods for pilots to carry out practice emergencies and to obtain position-fixing services. It has been demonstrated statistically that the use of the emergency frequencies for training has no affect on the availability of a response from D&D; in fact, the ability of D&D to select specific transmitters allows the simultaneous use of 121.5MHz in different parts of the country with no breakthrough or "stepping" on the aircraft transmissions. The ability to practise an emergency has a real and defined beneficial effect for both pilot and controller and we receive regular comments from pilots who were glad they once took the opportunity to call "London Centre". Although the use of 121.5MHz for practise is encouraged, we are judicious in it's use as it remains important to leave the frequency clear for it's primary use. Unfortunately, the use of 121.5MHz does affect those who are mandated to monitor the frequency whilst in flight so D&D actively monitors all transmissions. During surveys carried out over the last few years, it has been shown that 70% of all transmissions are made by pilots (in commercial aircraft) inadvertently transmitting or misusing the frequency. Currently, practice PAN's and Training Fixes make up around 7% of all transmissions on 121.5MHz.

## Rewarding Work

Without a shadow of doubt, the role of a D&D controller can be one of the most rewarding experiences for an Air Traffic Controller. The sheer diversity of emergencies, aircraft types and airspace issues require quick-thinking and a knack for problem-solving. Although D&D is usually at the hub of any aircraft emergency, it is the interaction with colleagues throughout the aviation spectrum that can be critical to the success of any emergency situation. So, if you are a controller at a busy international airport or a FISO at a regional airfield, you can almost be certain to speak to D&D at some time (don't worry, we don't bite!). For those pilots out there who wish to use D&D services (hopefully for practice!) a useful guide to our services can be found at http://flyontrack.co.uk , click on the Links page to download a handy pocket-sized D&D reference guide.

Here's to a safe and sunny 2012!

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# Military Interception

by Wg Cdr Davy Jones

**"Air Europe 123, this is London Centre on 121.5 acknowledge or squawk ident". A call we have heard all too often. Whilst the call sign is fictitious the rest of the transmission is unfortunately one we hear on a daily basis. We being the Royal Air Force National Air Operations Centre (NAOC) charged with the air policing of the UK and located deep underground somewhere west of London!**

The RAF maintains a number of armed fighter aircraft on alert for air policing duties, both NATO and national. The crews are normally dismounted but are able to be in the air in an extremely short space of time.

For years the threat was the Soviet Air Force and naval long range bombers and maritime aircraft and, indeed, we still have flights into the UK FIR by Russian long range aircraft.

Whilst they have every right to fly in the UK FIR, outside territorial waters, unfortunately they do not squawk and thus are invisible to civil ATC. Therefore we will scramble and escort these flights enabling civil ATC to 'see' and avoid these flights preventing any flight safety hazards.

However, since 9/11 we have had to acknowledge that there is a potential threat to the UK from terrorist organisations utilising civilian aircraft (most likely airliners) as weapons of mass effect with enormous human, economic and psychological consequences. We must counter that threat.

Within the NAOC there is myself (an Air Defence Wing Commander ex-fighter type) and a small team on 12-hour shifts, day and night all year round. We are at the strategic level; it is not up to us to monitor the airspace continually. We have a much larger team at the Control and Reporting Centres (CRCs)

compiling the air picture, watching the airspace continually and working hand-in-hand with civilian ATC at Swanwick and Prestwick. However, we will always be monitoring 121.5 throughout the whole of the UK FIR and a call such as the above will start an immediate reaction.

The first call will get our attention but quite often, and some carriers are better than others, an immediate response will be heard and a new frequency allocated. However, a second call and we are up and responding; the team will pull up the flight plan on the tote (we have access to all flight plans in the UK FIR) and we will highlight the route on the screen. We will work out a rough expected position based on the filed flight plan but at the same time the CRC will have found the track and labelled it with the callsign.

We have exactly the same equipment and picture as the CRCs, thus as soon as it is high lighted we will see it, all eviating any need for the CRC to call us. Quite often at this stage it is obvious that there is nothing sinister with this incident, for instance the aircraft is out bound from the UK FIR and is too far away for radio communications.

However, if the track is inbound or gives us any other cause for concern then we will be contemplating tactical action even at this early stage.

If the aircraft remains out of communications, London/Scottish will contact the duty CRC on the dedicated line with the basic details.The CRC will change the tac label to highlight the track thus alerting all, including our NATO colleagues, that there is a potential incident in the UK FIR and will contact us with the details; the aircraft officially becomes a 'lost - comms' at this stage.

Depending on the location, routing and any other information I may have will dictate my reaction, but most likely I will order RAF fighters up to cockpit readiness; which is crew in the aircraft, power on and ready for immediate start. Some may think that this is a bit of an over-reaction at this early stage but time is of the essence if we have to scramble and successfully intercept prior to any potential target being reached, and all we know at this stage is that for some reason these pilots are not responding to ATC instructions on the assigned frequency and also are not listening out on guard (121.5).

Whilst the fighter crews are 'coming to cockpit' I will contact the duty officer at Transport Security (Transec) within the Department for Transport requesting that they contact the airline operations concerned and have them attempt to raise their aircraft by any means of 'secondary communications' (e.g. ACARS, SATCOM or mobile phone) and have them contact ATC immediately, normally on guard. Some are better than others at contacting their flight crew, and indeed some, even major carriers, have no secondary communications.

Additionally, in the case for instance of a bizjet or another general aviation aircraft, where there commonly is no 24/7 operational support centre, Transec may have difficulty raising the aircraft. However, usually this, together with continuing attempts by ATC to raise the aircraft, will be sufficient and we will hear a some what chastened voice on 121.5 requesting a new frequency. Once ATC have re-established communications we will stand our crews back down.

However, what if the company cannot contact their crew, and the flight is still not talking to ATC? We will then most likely scramble a pair of fighters to intercept the aircraft as quickly as possible.

From our point of view we have to assume the worst and until I get evidence to the contrary, I have to assume that this aircraft poses a potential threat to the UK.

Once airborne, our Aircraft have priority over all other aircraft, and thus a number may have to be rerouted out of our way, causing delays and expense to a lot of other flights and air lines. Additionally, depending on the location, departures maybe stopped, arriving aircraft put in the hold or even diverted so the knock-on effect to an airline's operations can indeed be extremely costly!

As we approach for the interception our fighters will be attempting to raise the suspect aircraft on 121.5. If the aircraft answers our call we will remain well astern and once satisfied that nothing is amiss we will recover to base. However, if assistance is required we will readily give it and in the past, we have escorted Aircraft to agreed diversion airfields.

Unfortunately, sometimes we have to continue and intercept the aircraft. We will always approach from astern, having completed a very wide intercept and with our mode C switched off (thus avoiding TCAS RAs).

As we approach we are looking firstly to confirm the identity of the aircraft, and secondly whether there is anything unusual - all lights out may signify an electrical emergency which could explain why there has been no radio communication!

One aircraft will approach on the left hand side and forward of the cockpit so that they are easily visible to the captain. The fighter crew will again call on guard and we would expect an immediate acknowledgement on 121.5.

If there is no acknowledgement we will attempt to ascertain by looking in the cockpit or visual signals what is the problem and whether there is an emergency or something more sinister.

By means of visual follow-me signals i.e. rocking our wings and turning to the left we will confirm that the flight crew or whoever is flying the aircraft is compliant with our instructions.

Whilst all of this is going on I will be in constant touch with the highest levels of government. Assuming that there is an emergency and we are required to lead you someplace we will convey our intentions by visual standard ICAO signals. Suffice to say that if there is something more sinister then we have to have and do have procedures in place to deal with any situation.

As I said earlier, some may say this is an over-reaction. However, until we can positively ascertain that there is nothing sinister in progress, that the flight crew or even cabin crew are not under duress and that the cockpit door is secure, we must assume the worst and that this aircraft poses a threat and could be used as a weapon to devastating effect.

Thankfully we rarely get to the stage of an interception. Indeed more often than not we can look at the situation early on and assess that this is not a threat but probably just a wrong frequency on handover or some other explanation.

It is however a daily occurrence for us to have to bring our crews to a higher state due to a 'lost -comms' on guard. We do not scramble as often as our colleagues in some other European countries but we certainly will if we feel the situation dictates and a potential threat exists. (Be warned, whilst there is currently no charge in this country for our time and costs, some of our European colleagues do indeed charge and in some countries it is not the airline but the flight crew who are fined!).

Where a lost comms occurs we would encourage the flight deck crew to report it, particularly exactly what happened and the reason why. Depending on the case, Transec will contact the airline concerned to ascertain what happened and what steps, as appropriate, are being taken to reduce the possibility of a recurrence. Transec and ourselves stand ready to help with this, e.g. by offering briefings, as required.

I have a number of ex-RAF friends who now fly for the airlines and they have explained your procedures and why sometimes, particularly when there are only two radios, you may not be monitoring guard: for instance, when you are getting the weather or talking to the handling agent or operations. This is of course completely understandable and a few minutes off guard is acceptable. However, a recent incident I had was a crew over Germany with Maastricht who had 'lost comms' and were inbound to an airfield in UK. They flew for 40 minutes prior to the UK FIR without talking to any ATC agency, failed to check in with London at the FIR boundary and flew for a further 30 minutes before we intercepted. So for over an hour they had flown through some of the busiest airspace in the world without talking to anyone and not monitoring guard. All that time Maastricht, London and a host of other aircraft were calling them on guard.

Additionally they failed to acknowledge the calls of their operations centre who had been contacted by the Germans, Dutch and UK authorities and only selected guard when we were alongside!

Departures were stopped at Stansted, Heathrow and Luton and a great number of aircraft were moved out of the way. The overall result was a huge amount of disruption to a lot of passengers and a great deal of extra costs incurred by a number of airlines, and all because a crew were not monitoring 121.5.

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