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

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Front Cover Picture: A Voyager from RAF Brize Norton flies in formation with a Tornado. The Voyager programme will see the delivery of the final aircraft later this summer to AirTanker Services which will mark the delivery of the full fleet of 14 aircraft.

focus ON COMMERCIAL AVIATION SAFETY

"Regulation - the European journey"

by Dai Whittingham, Chief Executive UKFSC

Working in aviation safety can be frustrating and even tedious at times, as we crunch numbers, review trends, revisit the same subject month after month, identify threats and hazards, investigate incidents and try to work out ways of making things better. Though we appear to be succeeding in bringing down the rate of safety-related incidents and accidents, we eventually bump up against the fact that our desired changes can often only be achieved by regulation or legislation, or at significant cost, and we are therefore in the hands of other people who may not share our priorities or even our conclusions on a particular matter.

The wheels of change can turn too slowly for comfort, especially when they have an international dimension and become subject to national interests and politics. Progress when it involves trans-national bodies such as ICAO can be glacial, with most major changes requiring a 5-10 year timeframe in order to align all parties. Typically, progress becomes a compromise and ideal solutions are diluted until they are acceptable to all. Sometimes the dilution and delay can reflect the difficulties of crafting a regulation that fixes the problem at hand without creating one elsewhere, on other occasions it may be differences in culture, the odd vested interest, or sometimes the sheer bureaucracy of the change process that puts the brakes on. But at the end of the day there is usually progress, and even a 50% improvement is better than no change at all. What matters is that we don't stop trying to make things better.

Laser attacks are a case in point. The number of attacks in the UK shows no sign of decreasing, despite some high profile incidents such as the recent Virgin air-return, evidence of spill-over into other transport domains, sporting events and, sadly, incontrovertible evidence of permanent and disabling eye injuries to school-aged youngsters who have either misused laser devices or who inadvertently gained possession of high-power devices. There is enough information out there to let even the most uninformed members of society know that lasers are dangerous, but the aviation cause has not been helped by pilot failure to report each and every attack.

The UK Laser Working Group (which I chair) is well aware of the under-reporting problem and understands that it is often easier not to report because of time pressures and, sometimes, because it does not seem important – after all, most of the time nothing happens and prosecutions are rare when set against the 1500+ attacks every year in the UK. It can also be difficult for our police colleagues to gather the evidence they need and it is too easy for offenders to evade detection. The evidence shows that current legislation is not effective in reducing the number of laser attacks, and there are genuine concerns about the ready availability of high-power devices via internet purchases – some of these devices are capable of producing disabling eye injuries at distances of more than 100m.

The good news is that there are definite signs of movement in the UK Government position on lasers. A survey for BALPA, which asked pilots whether they had been subject to a laser attack and whether they had reported them, revealed that the scale of the under-reporting was in the order of 35%; similar results were obtained by the Honourable Company of Air Pilots. We were able to use this evidence to convince officials that the problem in aviation was much larger than the formal reporting system indicated. It was also made clear that, unless reported to ATC at the time, attacks on foreign-registered aircraft – which comprise 50% of the CAT traffic in the UK – would be reported in the state of registry and not to the CAA, which introduces a further significant factor in under-reporting.

Any change to legislation needs to cater for the wider problem of laser misuse if it is to be fully effective. For example, aviation legislation is not going to be the correct tool to control the importation of laser devices capable of causing injury, nor can it deal with laser misuse at sporting events and the like, so we have had to lobby for a multi-modal approach that is going to require co-ordinated work between several Departments. We can't yet say how any new legislation might be achieved, but political support has been gained and the work appears to be gathering momentum. In the meantime, laser misuse remains a global problem.

Laser misuse is a classic case of technology being used in ways its inventors never intended or envisaged. Nobody involved in the development of laser pointers would have thought about them being used in the future to distract or dazzle pilots, drivers, ship crews or sportsmen and women, or that they would ever be used deliberately to blind people. The same is true for drones, where availability on the mass markets has led to genuine safety risks for other airspace users. The issue we will always face is that technology and any associated, unexpected safety hazards will always lead regulation by several years, which means that regulations should contain an element of future-proofing if at all possible. By the time a problem has become apparent, the scale and pace of development mean you will always be trying to put the genie back into the bottle, and the lawmakers will need evermore evidence before being able to tackle the original hazard. And there will always be conflicting interests.

Drones numbers have exploded in the last 2-3 years, at least if the importation statistics here are to be believed. The UK is not alone in the problem of managing drones (or lasers) but it is going to be some time before EASA can catch up and fix a solution applicable across all 32 Member States and which caters for unmanned platforms of all sizes, capabilities and intended use. Add to this the understandable intent of individual governments to support and encourage their drone sectors, a generous cupful of commercial opportunity, a couple of tablespoons of resistance to change, stir well, and then admire the immediate tension between what is desirable or required to solve the safety problem and what is achievable on the political stage. It is not easy.

There is also no denying the increasing size of the drone problem, however convenient it may be to do so. The initial figures on UK Airprox incidents for 2015 (with all reports now having been analysed) show that of the 49 incidents reported by commercial air transport pilots, 22 were considered to be risk-bearing (Cat A and B). And of those 22 incidents, 19 were attributed to drones or other flying objects ('unknowns'). By mid-May, there had been 70 Airprox, of which 23 involved drones or unknowns. Heathrow alone has had 22 reported drone sightings this year, compared with 9 during 2015. Despite the existing legislation that limits small drones (sub-20kg) to 1000 ft or below, the bulk of the reported drone encounters have occurred above 1500 ft, mostly in controlled airspace; the highest sighting to date has been at 13,500 ft. It is these figures and the associated irresponsible behaviours that have prompted the Government to enhance drone legislation as part of the recently announced Transport Bill.

Whatever the cause of the regulatory lag, there is one issue EASA needs to address as part of its rulemaking programme, which is to institute a mechanism capable of providing rapid remedies for the unintended consequences of a regulation. As part of this, there is a real need to ensure that the intent behind any piece of legislation is properly captured at the outset, as it will help make clear which consequences were intended and which were not. That principle applies to any 'rule' you make, including SOPs – if you are going to change something, you need to record why you are doing it and what you want to achieve. If unintended legislative consequences are unacceptable, Member States can always issue derogations, but these are inevitably bounded by time and produce inconsistencies in the approach between countries. Given that the airspace is contiguous from one side of EASA-land to the other, harmonised regulations and processes seem to be the obvious answer in ensuring that we all share the same understanding of our aviation environment. Which brings us to 'BREXIT'...

It would be inappropriate for UKFSC to take a formal position on 'BREXIT' as, firstly, we are an apolitical organisation and, secondly, we are likely to find it impossible to agree a position acceptable to all members – bearing in mind, of course, that the Committee attendees are representatives of their member organisations and therefore should be aligning with corporate policies rather than individual stances. What can be said without taking sides is that seceding from the European Community could leave UK aviation in a regulatory limbo that would require the development of a whole range of competences within the CAA if it was to resume all the regulatory tasks it carried out prior to UK adoption of the JAA protocols. These competences would inevitably come at a cost and take time to install, and much of the pre-EASA experience is no longer available. There would also be a question about the standards to which the UK would conform outside the EASA system, given that JAA no longer exists.

If the BREXIT referendum next month determines that the UK's future lies outside Europe, the unravelling of the various treaties, laws and other arrangements is going to take some time – there is a 2 year period for the primary negotiations to be completed. During this time the UK would still be signatory to the Treaty of Rome (until formal secession) and hence we would continue to be bound by the EC Basic Regulation and EASA's implementing rules. The logical position thereafter would be to remain within the EASA system as a Member State but outside the EU, which would mean that standards for operations, airworthiness, maintenance and licensing would be harmonised and the UK carries on as if there had been no change in the political landscape. For example, pilots would have a UK-issued but EASA-compliant licence. The downside of such an arrangement is that, as a non-EU member, the UK would be non-voting and hence wholly unable to influence development and application of the regulations and standards. It will be for others to judge whether that is a price worth paying.

Europe aside, there is one other notable exit we must consider, namely the imminent departure of Chris Brady, our current Chairman. Chris has represented easyJet on the Committee since 2008 and he has been an Executive Board member for the last 4 years. His tenure as Vice-Chairman rapidly involved him in deputising for the then Chairman and the position was formalised in September 2013 when his predecessor moved abroad, so he has in effect occupied the Chair for most of the last 3 years. Throughout this time he has given us strong and thoughtful leadership; he has always participated fully in our Safety Information Exchange meetings, providing interesting and relevant material for the information exchange, and contributing perceptively to the discussions that follow. Chris has also been an active member of the Executive Board, and he has been a very positive influence in determining the future development of the Committee while keeping its existing management (me!) on track. From a personal perspective I have very much valued his support, friendship and wise counsel during his time in the UKFSC's left hand seat. Chris, thank you for all you have done for the UKFSC over the years, and in particular for your extra efforts as one of our officers. I know your friends and colleagues will join me in wishing you every success in the future.

Regaining Control

by Chris Brady, Chairman UKFSC

Source: *The wreckage of the FlyDubai 737-800 laid out on a hangar floor by investigators. (Photo MAK)*

Today, as I write this column, an Egyptair Airbus 320 has been lost over the Eastern Mediterranean en-route to Cairo. All 66 passengers and crew are feared dead. Only two months earlier a FlyDubai Boeing 737-800 crashed during a go-around at Rostov On Don; all 62 passengers and crew perished. Just over a year ago an Air Asia A320 lost control in-flight and crashed killing all on board. The Tartarstan 737 in Kazan in 2013 and of course AF447 were also examples of fatal loss of control events. According to Skybrary, in flight Loss of Control is the biggest single cause of transport aircraft fatal accidents and hull losses.

These were not tired old aircraft, they were the latest generation airliners, the types of which between them make up the vast majority of the worlds airliner fleets. We know that these are both amongst the safest types of aircraft. These are accidents which with all the years of operation of these types, the lessons from previous accidents and incidents should by now have been eliminated with design improvements, more robust SOPs and better training. They should not still be happening, but they still are. Why?

This is huge subject, the holy grail of aviation is how to prevent accidents, so I can't possibly answer it here but there are some reasons why progress is slow. Aircraft design changes happen all the time but these are usually slow incremental changes such as software updates which give minor improvements but significant changes are often reserved for a new generation of the type. Even then, major changes cannot always be incorporated because they would be beyond the scope of the original type certificate, eg making the 737 Fly-by-wire or interconnecting the Airbus sidesticks. SOPs are also often tweaked with the best of intentions by Flight Ops departments leading to a cumbersome layering of SOPs and thicker manuals; but occasionally a radical rethink of the whole process may be what is required. This is not easy and there is always the spectre of unintended consequences lurking over your shoulder. Training has improved over the years with initiatives like ATQP but sessions in the simulator still revolve around the same old script (EFATO, S/E ILS to a G/A, NPA etc) that was given to previous generations, albeit with new exercises bolted on. Tie all of the above in with the inevitable cost savings that airlines have had to make to stay competitive which affects time allowed in the simulator, a reduction or loss of face-to-face recurrent groundschool training, defects carried on aircraft, shorter turnaround times, the squeeze on crew productivity and

Source: *A hypothetical RECOVER button.*

the effect on fatigue and the picture can look bleak. So what is the solution? I believe that part of it may lie in automation.

Let us take the FlyDubai/Tartarstan examples in which it appears that control was lost during the go-around. Those of us who have worked in flight safety departments (or as TREs) can tell you that we have seen some horrendously flown go-arounds in which safety has certainly been eroded. These have often required some quick thinking and occasionally luck on the part of the crew to recover themselves from the situation that they got into. My question is why can so many highly trained crew occasionally find a go-around so difficult? If this is the case, then surely the manoeuvre needs simplifying. Why not modify the existing "TOGA"/"GO-AROUND" functions on Boeing/Airbus thrust levers so that when engaged the aircraft performs the whole manoeuvre automatically? i.e. with one selection it will engage the autopilot, flight director and autothrust; fly the published missed approach vertically and laterally; and move the flap and gear as required, thereby giving capacity back to the crew to monitor and manage the process.

There are those who may say that such a function would further erode the flying skills of pilots. This is a risk but I would argue that as with all autopilot functions, its use would be at the discretion of the Captain, and could simply be used when needed. Automatics are not simply labour saving devices that hold height and heading for us on an airway, these days they are essential safety tools that can fly complex RNAV approaches. Who amongst us would like to return to the days of hand-flying non-precisions approaches after we have tasted the luxury of 737s and A320s which can do the whole thing automatically? It might be nice to do for old-times sake on a CAVOK day into a quiet airfield, but on a dark and horrible night like the crew had at Rostov on Don we would, and should, all take the automatic option.

Returning to how to prevent loss of control events in the future, how about a button located prominently on the MCP/FCU labelled "RECOVER" or similar which would apply the standard upset recovery procedure, again including any necessary reconfigurations? Could such a facility have saved AF447 or the Air Asia A320? Such functions should not be seen as any disempowerment or distrust of pilots but rather as a "get out of jail free card" for when things are really desperate. These would be the airliner equivalent of an ejector seat, when the situation has got away from you, you simply press the appropriate button and hey presto the aircraft sorts itself out. One thing is for certain, if we are still losing modern airliners flown by highly-trained crews in loss of control events from go-arounds or the cruise, something more needs to be done.

A Guide to Aircraft Recovery

by Steve Hill, McLarens Aviation

"Authorities confirmed that following an off runway incident that occurred at 0830 local, the airport will be closed until further notice until the aircraft can be recovered and appropriate NOTAMs were issued."

The pressure is on, a runway is closed and aircraft are being diverted, an urgent solution is required. Situations such as this can occur at any airport around the world, sound preparation and planning are required to reduce the impact and to get safe operations resumed at the earliest opportunity.

It is with these real life situations in mind that we have pioneered a course offering insight and practical training in aircraft recovery techniques. The course is now in its second year of operation and over two days focusses on the planning for and managing of an event, including a practical exercise where candidates get the opportunity to train on and use specialist recovery equipment such as air bags, slings, temporary roadways and lifting equipment. Early preparation and training for such an event can mean that airports and operators themselves are left in a much better position and more confident to respond quickly and effectively following an incident. Moreover, from an MRO perspective, gathering as much information and factual data at the earliest opportunity will help establish the potential resource requirements to enable an initial damage review. From this review, the formulation of a viable recovery plan taking into account further variables such as weather and terrain can be undertaken. So what are the lessons for any aircraft recovery scenario?

As with any crisis situation, planning is crucial and there are some important points to consider:

1. Follow due process: Every aircraft recovery scenario is unique and on that basis it is imperative that the recovery manager seeks permission to enter site and meets with the investigating authorities, airline, airport operator, police and emergency services, before any initial damage surveys and recovery plans, environmental considerations are initiated, to enable a full understanding of the situation and aircraft fuel/load configuration. Every recovery requires a survey, detailed planning, and sound preparation before it is undertaken. The initial actions will cover the preliminary planning, an assessment of onsite hazards, the condition of the aircraft, the condition of the site and weather both actual and expected.

2. Put safety first: Modern aircraft construction uses significant amounts of lightweight material, such as carbon fibre which when exposed to heat and temperature can result in residues of minute toxic shards of carbon fire that pose a significant health hazard if inhaled or absorbed through skin. The wearing of the correct personal protection equipment (PPE) is therefore vital. Fire hazards from residual fuel left in the aircraft and any hazardous cargo for example Lithium ion batteries needs to be considered via a review of fuel loads and cargo manifests.

3. Expect the unexpected: Given the nature of these operations and the potential variables, they can become very fluid and best laid plans may be subject to change at short notice, dependant on factors, such as terrain, weather conditions, structural integrity availability and serviceability of equipment. It's also worth noting that these events often occur due to weather related factors and the subsequent recoveries can take place in the most inclement weather conditions and often at night, if the airport is still operational.

4. Communication is key: Perhaps unsurprisingly, the most important factor to consider is good communication, leadership and regular meetings with the appointed representatives of all relevant parties at key stages to ensure a safe and successful outcome of the recovery.

After planning comes **implementation**. In the training scenario that we run - a fairly typical aircraft grounding – this is the point when personnel are deployed to the site to take stock of the situation and select the appropriate equipment for the task of aircraft stabilisation. This includes a heavy compressor, airbags and safety tethering cables so as to pull the nose out of the mud. Once the nose is raised, a safety jack is positioned to enable the nose landing gear to be inspected and landing gear safety pin installed, allowing for the next phase of the recovery to begin. At this point the safety jack is removed and airbags deflated, to allow temporary roadway tracks to be positioned along the recovery route to avoid the aircraft bogging down during its recovery back to the runway. It's at this point that teamwork comes into play; whilst one party may continue to focus on roadway preparation, other team members unpack tow lines and associate digital load cell measuring equipment to monitor loads on the main landing gears during the pull. Our particular scenario required a 32 ton tractor in place, with a team strategically placed to monitor the operation and ensure safety lookouts were in place for slow controlled recovery of the aircraft back to the runway paved area without further damage to the aircraft or the airport infrastructure. In this instance it took five hours after the practical exercise commenced for the aircraft to be reunited with the runway, towed to the maintenance area and the runway declared open, though it goes without saying that this will differ from incident to incident.

In combination with the class room sessions covering complex situations on day one and the hands on experience of an incident such as that covered in the exercise, leaves the participants with a sound awareness of how to deal with an aircraft recovery.

Steve Hill is a loss adjuster at McLarens Aviation who also leads the Aircraft Recovery course. Steve has extensive knowledge of the business of recovery gained from his forty years in the industry. McLarens Aviation ran the course in conjunction with Air Salvage International and AMS at Cotswold Airport.

First published by MRO Network

Asiana Airlines 214 – Boeing 777-200ER, HL7742 San Francisco 6 July 2013

by Dai Whittingham, Chief Executive UKFSC

On 6 July 2013, a Boeing 777-200ER operating as Asiana Airlines Flight 214 hit a seawall on a visual approach to runway 28L at San Francisco International Airport (SFO). Three of the 291 passengers died; 40 passengers, 8 flight attendants, and a flight crewmember were seriously injured. The NTSB investigation revealed a mismanaged descent leading to an unstable approach, and it identified issues with training, SOPs, manual flying skills, and design complexity. The investigation also made a number of recommendations relevant to crash-worthiness and the ground emergency response which will not be considered further in this article.

Overview

Flight 214 was a scheduled flight from Incheon, Korea. The primary crew comprised a trainee captain (PF) and an instructor pilot (PM), with a second captain and first officer as relief pilots. The aircraft was vectored for a visual approach to runway 28L and intercepted the final approach 14 miles from the threshold at an altitude slightly above the desired 3° glidepath. At 500 ft AAL, the aircraft was slightly above the desired glidepath but the airspeed was decaying, the thrust levers were at idle, and rate of descent rate was high; as the approach continued, it became increasingly unstable. At about 200 ft, the crew became aware of the low airspeed and low flight path but did not initiate a go-around until the aircraft was below 100 ft, too late to avoid ground impact.

The main landing gear and aft fuselage struck the seawall and the tail broke away at the pressure bulkhead. The main landing gear and both engines separated cleanly from the airframe as designed. The aircraft slid along the runway, lifted partially into the air and spun through about 330° before a final ground impact. The impact forces resulted in the inflation of two slide/rafts inside the cabin, which injured and trapped two flight attendants. Six people were ejected during the impact sequence: two of the three fatally injured passengers and four of the seriously injured flight attendants. The four flight attendants were wearing harnesses but were ejected when the aft galley was disrupted as the aircraft broke up. The two ejected passengers (one of whom was later run over by two fire vehicles) would probably have remained in the cabin and survived if they had been wearing their seatbelts. After the aircraft came to a stop, a fire started in the separated right engine, which had come to rest adjacent to the right side of the fuselage. When one of the flight attendants became aware of the fire he initiated an evacuation, despite instructions from the flight deck to the contrary, and 98% of the passengers successfully self-evacuated. As the fire spread into the fuselage, ARRF firemen entered the cabin and extricated five passengers who were injured and unable to escape unaided.

The Crew

The PF had 9,600 hours, including 3,700 hours as PIC on B737 and A320 but only 33 hours of B777 flight time and 24 hours of B777 simulator time. The PF began transition training to B777 captain on March 25, 2013, completing his simulator proficiency check on May 18, 2013, and his line-oriented flight training check on May 30, 2013. His simulator training included six visual approaches, two without an ILS glideslope. He began flying with an IP as part of his required initial Operational Experience on June 16, 2013, some 3 weeks before the accident, and had completed around half the 20 sectors and 60 hours flight time required by Korean regulations.

The IP, flying as PM, held type ratings for the B757/767 and 777. He had 12,000 total flight hours, including 9,000 hours as PIC with 3,200 hours in the B777. He underwent B777 IP training in May - June 2013 and became qualified as an IP on June 12, 2013. The accident flight was his first time acting independently as an IP.

The Approach

The PF briefed the approach and was expecting vectors for a visual to 28L; as the ILS GP for both 28L and 28R were out of service he would use the LOC to control the lateral path and the AFCS to manage the vertical profile. The Vref was briefed as 132 kts and MDA for the approach was 460 ft. SFO's elevation is 13 ft. As the flight proceeded towards SFO it was cleared to progressively lower altitudes and given vectors to intercept a straight-in approach path to 28L.

Passing 6300 ft at 211 kts, clean, the A/T was in HOLD mode and the A/P Flight Director System (AFDS) was in FLCH SPD pitch mode and HDG SEL roll mode. (In HOLD mode, the A/T will not move the thrust levers; FLCH SPD pitch mode moves the elevator to maintain the selected airspeed; and HDG SEL roll mode maintains the selected heading.) The LOC mode was then armed and the 3100 ft step altitude selected on the mode control panel (MCP); shortly afterwards, LOC capture occurred and the AFDS roll mode changed to LOC, where it remained for the duration of the flight. The aircraft was now 15.4 nm from touchdown, descending through 5300 ft at 210 kts.

After prompting from the PM the MCP-selected altitude was changed to 1,800 ft, the minimum altitude for the DUYET waypoint 5.4 nm from the runway. Following a PM callout of "localizer capture" the PF asked for Flaps 1; the MCP-selected airspeed was then changed from 212 to 192 knots. At 14.1 nm range and descending at 900 fpm, the crew was instructed to reduce speed to 180 knots and maintain until 5 miles, which they acknowledged and set as the MCP speed. Shortly after this, Flaps 5 was selected and the MCP airspeed changed to 172 knots. Ten seconds after the Flap 5 selection, the AFDS pitch mode changed to vertical speed (V/S), the A/T changed to speed (SPD) mode, and the MCP-selected vertical speed was set to -900 fpm and then -1,000 fpm, which the PM acknowledged. (Note: V/S pitch mode maintains the selected vertical speed until the selected altitude is captured.)

There was no communication between the flight crew until thirty seconds later, when the aircraft was 9.5 nm from the runway, descending through 3,900 ft msl at 185 knots and descending at 1,000 fpm, when the observing FO commented that the flight was to maintain 180 knots until 5 miles; this was acknowledged by the PM and, after repetition, by the PF.

At 8.5 nm from the runway, descending through 3,500 ft msl with a descent rate of about 1,000 fpm, the PF called for the landing gear. There was a brief exchange about their height before the PF stated, "I will descend more"; the MCP-selected vertical speed changed to -1,500 fpm and later to -1,000 fpm. At 6.3 nm the aircraft was descending through 2,600 ft msl at 1,500 fpm. The PF called the missed approach altitude as 3,000 ft, which was then set on the MCP.

The flight crossed DUYET (5.4 nm) passing 2,250 ft msl (450 ft above the profile) at 176 knots and descending at 1,100 fpm. Flaps 20 was selected as the aircraft reached 1,900 ft msl, still descending at 1,000 fpm. Shortly afterwards the AFDS pitch mode was changed to FLCH SPD, and the A/T mode to THR (which commands thrust to maintain the climb/descent rate required by the pitch mode).

The AFCS responded correctly to the mode change by starting to slow the aircraft to the MCP selection of 152 knots and initiating a climb toward the MCP target altitude of 3,000 ft. The crew response was to select Flaps 30 and disconnect the A/P. The aircraft was now 3.5 nm from the runway, descending through 1,500 ft msl at 169 knots and with a descent rate of about 1,000 fpm.

The automatic forward movement of the thrust levers commanded when the A/T mode changed to THR was manually overridden by the thrust levers being moved aft and, when the thrust levers reached idle, the A/T reverted to HOLD mode. At 2.9 miles out, descending at 1,100 fpm through 1,300 ft msl, the PF replied to the PM's prompt by calling out, "target speed one three seven" (Vref+5) and shortly afterwards the MCP-selected airspeed changed to 137 knots. By this point, the flight crew should have been able to clearly see four white lights on the PAPIs.

The PF's flight director (F/D) was then turned off whilst the right (PM's) remained on. Over the next 8 seconds, the descent rate increased from about 1,000 to 1,500 fpm. There was a callout and acknowledgement as they passed 1000 ft. Ten seconds later, the aircraft was at 2.1 nm from the runway when it descended through 1,000 ft RA at 151 knots with a descent rate of about 1,500 fpm; it was 243 ft above the 3° glidepath.

Approaching 900 ft RA the FO observer called "sink rate sir", which the PF acknowledged, but the FO repeated the comment 7 seconds later. The rate of descent briefly reached about 1,800 fpm before decreasing, and the pitch attitude began to increase. There was a further FO call of "sink rate." At 1.3 nm the aircraft was descending through 500 ft RA at 137 knots and 1,200 fpm. The thrust levers were still at the idle position and both engines' N1 speeds were about 23%. The electronic callout announced "five hundred," and the PF called for the "landing checklist." Two seconds later, the system announced "minimums, minimums" and the PM stated, "landing checklist complete cleared to land" followed shortly by, "on glidepath sir," as the PAPI indication changed to two white and two red lights; the aircraft was descending through 400 ft RA at 134 knots and 1,100 fpm.

Approaching 1 nm, the airspeed dropped below Vref (132 knots) for the first time; the descent rate was about 1,000 fpm, and the PAPI indication changed to one white and three red lights. Over the next 5 seconds, the pitch attitude increased from about 2° to 4° nose up. At 0.7 nm and 219 ft RA, the airspeed was 122 knots (Vref -10), the descent rate was about 900 fpm, and the PAPI indication changed to four reds. Over the next 5 seconds, the pitch attitude increased to about 7° nose up and paused before continuing to increase.

When the RA system voice announced "two hundred" the PM stated, "it's low," and the PF replied, "yeah." The quadruple chime master caution alert then sounded; the aircraft was 0.45 nm from the runway at 124 ft RA and 114 knots (decreasing) but the descent rate had reduced to 600 fpm. Shortly after the RA system announced "one hundred", the PM called, "speed" and advanced both thrust levers. Two seconds later, the A/T mode changed from HOLD to THR, followed rapidly by stick shaker activation.

The stick shaker coincided with the lowest recorded airspeed of 103 knots. The aircraft was still about 0.35 nm from the threshold at 39 ft RA and descending at 700 fpm, the N1s for both engines were increasing through about 50%, and the pitch attitude reached about 12° nose up. The airspeed then began to increase. The PM then called out, "go around." 2 seconds later the airspeed had increased slightly to 105 knots and the stick shaker stopped. The initial impact with the seawall occurred as the N1 speeds for both engines were increasing through about 92%; the airspeed at impact was about 106 knots. The airspeed had been below the MCP-selected 137 kts for 28 seconds before the PM advanced the thrust levers just 7 seconds before impact.

The Evacuation

About 20 seconds after the aircraft came to a stop, the PM radioed the tower controller with the first of multiple but unintelligible calls over the next minute. When the cabin manager came to the cockpit and asked if they should initiate an evacuation, the PM said "no, please wait." The PM later reported that when he understood emergency vehicles were responding he actioned the evacuation checklist but was delayed because he could not find the QRH; he issued an evacuation order once the initial steps of the checklist were complete. The cabin manager went back to the PA at her station and told passengers to remain seated. Immediately after her announcement, she heard "evacuate!" so opened door 1L and began to command passengers to evacuate.

One of the forward flight attendants had seen fire and smoke outside the door 2R window and determined they needed to evacuate. Hearing the cabin manager making her announcement for passengers to remain seated, he told a colleague to stop her from making the announcement and simultaneously commanded the evacuation to begin. He did not hear a command from a flight crewmember and initiated the evacuation entirely on his own. The first doors opened 1 minute 33 seconds after the aircraft came to a stop.

The Investigation

There were no major anomalies detected during physical examination of the flight deck and flying control systems, and the engines had performed as expected. The NTSB conducted performance studies, and simulator work using a Boeing 777-200ER engineering flight simulator. The simulations indicated the aircraft had adequate performance for a go-around initiated 11 to 12 seconds before ground impact. Type rated and current test pilots from Boeing and the FAA flew multiple runs simulating visual approaches to runway 28L at SFO with the A/P off; they had no difficulty in achieving stable approaches on any of the nine runs started on glidepath and were always able to comply with Asiana's guidance to avoid descent rates in excess of 1,000 fpm below 1,000 ft agl and in excess of 1,500 fpm between 2,000 and 1,000 ft agl. When starting at the accident profile conditions (above glidepath), there was difficulty in achieving stabilised approaches, with pilots having to exceed the Asiana guidance to do so.

The PF's Asiana B777 transition training included detailed overviews of the autoflight system; the slides were based on screen captures of CBT lessons purchased from Boeing to which instructors added descriptions and references from the Asiana POM, Asiana FCOM, and the Boeing FCTM. The "Automatic Flight System" training module described A/T function during FLCH descent and stated that the A/T activates in THR mode and transitions to HOLD mode if the thrust levers reach idle. This module also included information about the forms of flight envelope protection provided by the A/P, which included stall protection. One of the module's slides included a statement that the A/P did not need to be engaged to provide flight envelope protection; the recurrent training module also did not indicate that the low speed protection would not activate if the A/T was in HOLD mode. There was evidence of some discussion during the training regarding the potential for the airspeed to drop if the A/T remained in HOLD mode and the A/P was disconnected. The Boeing 777 FCTM, upon which Asiana based much of its training, did not explain the conditions under which the A/T would not automatically engage.

The NTSB reported that the PF's statements indicated "he did not have an accurate understanding of the context in which the A/T would transition to and remain in HOLD mode as a result of manual thrust lever override. Interviews with other Asiana pilots, including some instructors, indicated that they also had inaccurate mental models of system design logic in these areas. Although this was likely due, in part, to inadequate training and documentation, it was also likely due, in part, to the complexity of the design logic and a lack of intuitiveness from a pilot's perspective."

The use of the F/D guidance also played a role in the accident. In accordance with an informal Asiana practice of keeping the PM's F/D on during a visual approach after the A/P was disconnected, only the PF's F/D was selected off. Because both F/Ds were not in the off position at the same time, the AFDS FLCH SPD mode remained active and the A/T remained in HOLD mode. If both switches had been turned off, the A/T mode would have reverted to SPD and hence maintained the MCP-selected speed of 137 kts. The NTSB recommended that Boeing include a specific statement on the reversion of the A/T to SPD mode when A/P and both F/D are off, in the B777 FCOM.

There were numerous human performance factors identified during the investigation (not all explored here), and the communication between crew members was far from optimal. Training deficiencies were relevant for both pilots. Asiana's automation policy emphasised the full use of all automation and did not encourage manual flight during normal line operations. The PF lacked confidence in his ability to fly a stabilised manual approach without ILS guidance, and his lack of exposure to straight-in speed-restricted approaches contributed to the mismanagement of the vertical profile into SFO.

The PM was placed in a difficult position on his first flight as an IP, by having an experienced captain as the trainee. Although the IP training syllabus included events in which the IP trainee had to identify dangerous situations and recover the aircraft, these occurred in a structured simulator environment where the problems were known in advance. The final stage of training involved two OE instructional legs and 2 check flights, during which the PM flew from the right hand seat but gave no instruction. Crucially, the PM had no opportunity during his training to instruct a trainee on an operational flight, nor was he supervised by an experienced instructor during his own OE.

Conclusion

The NTSB found the probable cause of this accident was mismanagement of the aircraft's descent during the visual approach, the unintended deactivation of automatic airspeed control, inadequate monitoring of airspeed, and the delayed execution of a go-around. The complexities of the autothrottle and autopilot flight director systems and their inadequate description in Boeing's documentation and Asiana's pilot training, non-standard communication and co-ordination, and inadequate pilot and IP training, and degradation of manual flying skills were all identified as contributory factors.

This article is based on the NTSB Accident Report for Asiana Airlines Flight 214 (NTSB/AAR-14/01) dated 24 June 2014.

The dark side of pilot fatigue

We know the immediate effects of fatigue have the potential to be disastrous, but how could long-term fatigue affect your mental well-being in the long term? Here BALPA's 'Focus on Fatigue' team explores this vital issue

To date, much of our focus has been on the safety impact of fatigued pilots. But what about the impact on pilots themselves? The physical effects of sleep deprivation are easier to talk about but what about the impact on longer-term mental health?

BALPA is aware of cases of longterm sickness related to fatigue and 'burnout' across the Association, but also an increased demand for part-time work. These are worrying indicators that a pilot's workload may not be sustainable and the next phase in our 'Focus on Fatigue' campaign will look at these long-term health implications for pilots.

Shift and night work are medically recognised risk factors for health and well-being as they interfere with four main spheres of life:

1. **Basic biological functions** – Circadian rhythms are disturbed, beginning with the sleep/wake cycle
2. **Performance and work ability** – Due to fluctuations in performance and efficiency over 24-hour time period
3. **Social relations** – Difficulties maintaining normal relationships with family and friends
4. **Health** – In the short term this can be manifested by sleeping disturbances, anxiety, irritability and hormonal disturbances.

And in the longer term this may result in more severe cardiovascular, gastrointestinal and neuropsychological disorders.

The Impacts of Longterm Sleep Deprivation on Mental Health

The pilot lifestyle of shift work, night work and time zone changes, combined with more demanding, yet EU regulation-permissible rosters, are not conducive to regular and predictable sleeping patterns. So what can this mean for mental health?

Given that a single sleepless night can cause people to be irritable and moody the following day, it is conceivable that chronic insufficient sleep may lead to longer-term disorders.

Human physiology and behaviour is regulated by near-24-hour cycles known as circadian rhythms. Functions such as body temperature, hormone production and digestion all work to 24-hour cycles and so when the sleep-wake 24-hour cycle is disrupted it is no surprise that it can have knock-on effects on your well-being.

Shift work (in particular changing shift patterns) and time zone changes can both cause 'circadian rhythm disruption', so as you can imagine pilots are particularly susceptible to circadian rhythm disorders.

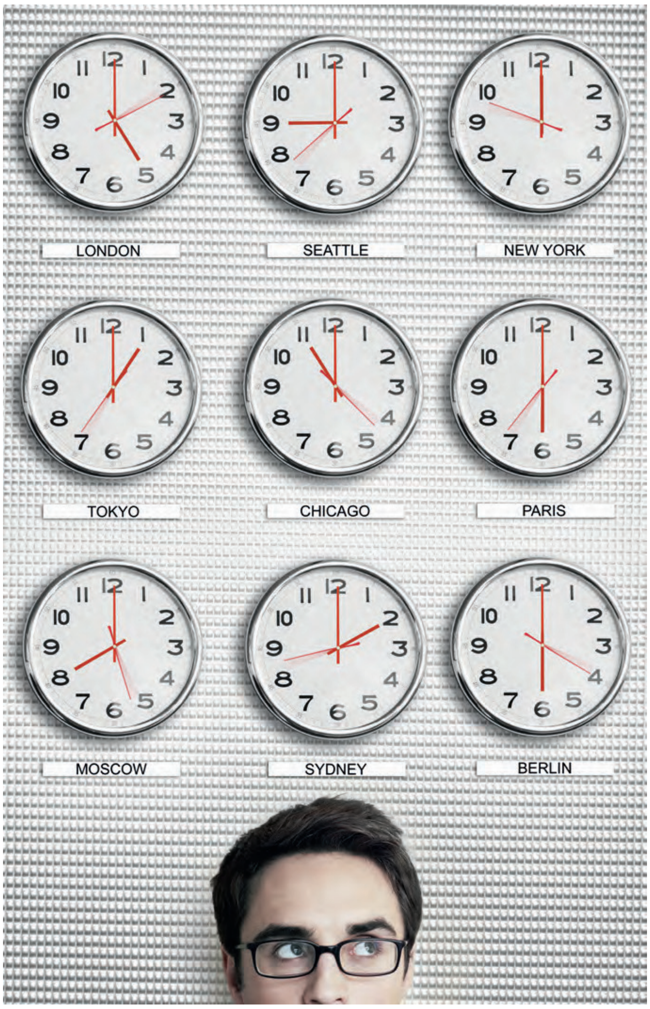
In the short term such disorders can produce feelings of fatigue, sleepiness, insomnia, digestive troubles, irritability, impaired mental agility and reduced performance efficiency.

Sleep deprivation is the main issue affecting shift workers, as sleep length and quality will vary depending on the different start and finish times of each shift. After a night shift it can be difficult to fall asleep and sleep longer because of daylight and noise – sleep can be reduced by two to four hours, is more frequently interrupted and is of a poorer quality REM and stage two sleep. In the case of an early morning shift, sleep is reduced by having to wake early and not usually compensated for by an advanced bedtime. Of course, a changing pattern of late and early shifts can further complicate the onset and length of restorative sleep.

A further complication is crossing time zones where pilots must cope with shifted waking hours in a changed environmental context and the loss of external time cues which can lead to circadian 'desynchronisation'.

Such disruptions to sleep length and quality can lead to sleep disorders. Indeed 'shift work sleep disorder' is a medically understood phenomenon and it is estimated that about 10% of rotating shift workers (aged 18-65) have a diagnosable 'shift work sleep disorder'. The disorder is characterised by excessive sleepiness and/or sleep disruption for at least one month. In the longer term such sleep disorders can also cause further psychoneurotic symptoms such as chronic anxiety and depression, often needing treatment by therapy and/ or medication.

But you don't need to have a sleep disorder to experience mood disorders as a result of circadian rhythm disruption. When our circadian rhythms are disrupted and our bodies produce hormones at the wrong time of day, it can increase the chance of depression or worsen existing depression. For example, you might be producing melatonin in the day time which can cause you to feel dull, unstable, irritable and moody. Or conversely you might be producing cortisol (the stress hormone) at times when your body needs to rest. Cortisol is also produced as a result of stress (hence it being commonly known as the stress hormone) so one can see how it is possible that ongoing intensive pilot rosters combined with sleep disruption can lead to elevated cortisol levels, which in turn can lead to 'free floating anxiety' or distress.



Some people are genetically predisposed to cope with the demands of shift work, where others may struggle, or fall somewhere in between. Some people are clearly 'morning larks' and some are 'night owls', but also your age, gender, circadian structure, hardiness, neuroticism and sleeping habits can affect your ability to cope. Where some airline fatigue management and mitigation techniques are limited is their ability to predict individual pilot sleepiness as they almost always assume an equal response across all individuals.

What is Burnout?

'Burnout' is the term used to describe a chronic state of physical, emotional and mental exhaustion combined with doubts about your competence and the value of your work. Burnout is more common in high-achievers who, with their 'I can do everything' attitude, can ignore the fact that they are working exceptionally long hours and putting enormous pressure on themselves to 'cope'.

We don't yet have quantitative evidence of the burnout rate of pilots, but looking at the medical profession as a comparator, one study estimates 27% of physicians in the UK suffer from burnout and it's a phenomenon that is on the rise across professions. We are certainly hearing of more cases across the Association and we hear of 'burnout' clinics for pilots that have been set up in Portugal and Switzerland.

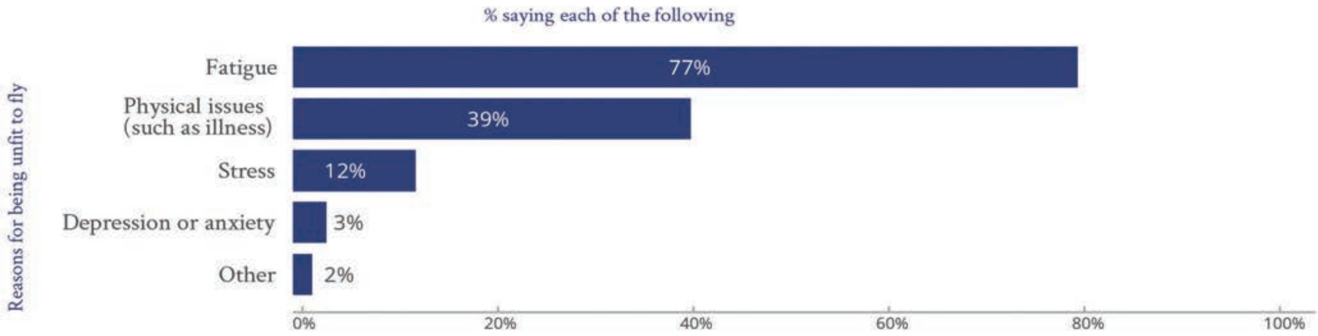
Clearly preventing and reducing work-related burnout is of great importance to pilots as individuals but also to prevent the economic losses for airlines which are a result of long-term sickness and potential loss of highly experienced workers. The business case for 'pilot well-being' is another angle from which this issue can be tackled.

Preventative Action

Of course, pilot roster construction is critical in reducing the risk of sleep deprivation, and BALPA's work in this area is ongoing. But what can pilots as individuals do to better cope with the demands of their roster?

Good physical fitness can be helpful for increasing tolerance for sleep disruption by lessening fatigue and improving recovery mechanisms.

Good sleep 'hygiene', including tightly scheduled sleeping hours, sleep routines, use of naps and arrangements to avoid disturbances.



Source: *ComRes 2015 polling of BALPA members*

Access to natural light can help, although the role of light is complex. If the light is bright enough it can promote phase adjustment of the body clock but at a lower intensity it can have a more general positive effect through general activation of the nervous system.

Healthy and regular meals are important. Those with late duties should have their main meal in the middle of the day instead of during the shift. Those on night duties should eat lightly during the shift and have a moderate breakfast before their sleep to minimise digestive discomfort. Pay careful attention to high carbohydrate foods and high sugar snacks as these can encourage sleepiness

Visit www.balpa.org/fatigue to view our Fatigue Reporting Guide

The use of stimulant substances, such as caffeine, can be used to temporarily counteract sleepiness when alertness is required but this does not address the underlying sleep deficit, and taking caffeine within four hours of sleep is likely to disrupt the sleep you get. However, it will assist in nap recovery so it can be beneficial to save caffeine use for the times in which it is really needed.

Further information on the contributors to sleepiness and fatigue can be found in the BALPA fatigue reporting guide that all members should have.

But what if the Problem Persists?

It may be that despite your best efforts to stay fit and manage your sleep you, or your family, notice that sleep is becoming a problem and/or other aspects of your mental health are suffering. You are a pilot who needs a Class 1 medical and if you don't have that, you can't work so there may be reluctance to take steps to address this medical issue.

Your first point of contact is your AME but if the AME is not immediately available and if you are in any doubt about your fitness you **should not fly.**

The AME will ask questions mainly around safety performance effects – any daytime sleepiness, symptoms of depression, difficulty in concentrating, etc. The AME will want to establish the potent contributors to your symptoms (domestic vs work stress for example) to make a judgement about how far down the route of medical investigation to go. Once a diagnosis is made a pilot might be referred to a sleep clinic or towards a range of psychological and psychiatric therapies. Selected pilots can fly while taking antidepressants and referral to see a CAA consultant psychiatrist should not be feared. Pilot feedback after these consultations is excellent.

BALPA is currently working with a renowned sleep centre to create a 'care pathway' for pilots with a sleep disorder which will include a specialist sleep disorder clinic for pilots.

The Hidden Problem

Our sense is that the current known cases of longer-term mental health issues related to fatigue are just the tip of the iceberg. Recent membership polling told us that 90% of pilots have known other pilots to fly when unfit to do so. And of those who have flown unfit, 12% cite stress and 3% cite depression/anxiety as the reason they are unfit. The majority (77%) cite fatigue as the reason, but given the inter-relationship between long-term fatigue and mood disorders, and the fact that pilots may not recognise (or be willing to admit) a mental health issue, we might expect the problem to be bigger than we think.

Working hours are just one contributing factor to these health problems, but with pilot hours increasing (and the recovery periods decreasing), it is conceivable that a cadet pilot today will retire having flown 40,000 hours by retirement, almost double what the average retiree today will have flown. If we are seeing problems now, what will this look like in 10 or 20 years? So while we continue our Focus on Fatigue programme to challenge rosters, improve reporting and support pilots we must not ignore this less obvious but insidious problem that will face pilots and our profession.

Have you been affected by any of the issues raised in this article? Would you be prepared to anonymously share your story to raise awareness of this issue? If so, please email *FocusOnFatigue@balpa.org*

Original article written for BALPA's The Log Magazine Spring 2016

TOP TEN TIPS FOR PILOTS

THUNDER STORMS

WHAT PILOTS **SHOULD KNOW**

- Controllers cannot see thunderstorm cells on their radars.
- Requests for specific weather avoidance headings/levels may result in you going outside of controlled airspace. Be familiar with ATSOCAS as the ATC service you will receive will change and you will become responsible for your own separation.
- A requested routeing may infringe the airspace of other controllers and co-ordination will need to be carried out before the routeing can be approved.
- Where multiple aircraft are weather avoiding, it may be necessary to separate all aircraft in the sector by level.
- Other aircraft which are avoiding weather may affect your routeing.
- Controllers can pass onto pilots information relating to thunderstorms gathered from Met feeds (not to the radar) and pilot reports.
- RTF workload will increase as weather avoidance causes an increase in calls and requests from pilots.
- The location of weather cells is dynamic; reduced landing rates, due to aircraft unable to land at airfields, will increase enroute holding.
- Sector capacity may be reduced to allow for increased separation requirements and loss of holding areas.
- If you turn to avoid weather without a clearance from ATC, you may no longer have separation from aircraft around you.

SPA
SAFETY PARTNERSHIP AGREEMENT

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

TOP TEN TIPS FOR PILOTS

THUNDERSTORMS

WHAT PILOTS **CAN DO**

- Tell controllers as soon as you know you will need to avoid a thunderstorm.
- Be precise when giving information on location and size of thunderstorm cells.
- Where possible, be flexible on what clearances you can accept - you may prefer to turn left, but can you turn right and still avoid the weather.
- When requesting a heading, advise the controller how long you anticipate it will be before you are clear of the weather.
- Advise ATC when clear of weather, but remain on the last assigned heading unless otherwise instructed. (The weather avoidance heading may now be being used tactically to separate you from other aircraft.)
- Be proactive; think about what you can do, as well as what you can't.
- Keep RTF transmissions to a minimum.
- If you can't follow the SID tell ATC **before** getting airborne.
- Give the controller as much warning as possible of diversion intentions.
- If you are unsure, always check.

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EASA Advisory Bodies and Safety Promotion

by Dai Whittingham, Chief Executive UKFSC

Because a large number of EASA actions and proposals directly affect the Member States and the Industry, a series of advisory bodies have provided EASA with a forum for consultation of interested parties and national authorities on its priorities, both at strategic and technical level. Consultation with the advisory bodies covers all aspects of the rulemaking process, and their work includes providing advice on EU-wide safety priorities, strategic and horizontal issues. These advisory bodies are key contributors to the EASA Rulemaking Programme and the European Plan for Aviation Safety.

Prior to decisions taken by the EASA Management Board in December 2015, its work was supported by an EASA Advisory Board (EAB) which included representatives from all sectors of industry, manufacturers and trade associations. Below this level, a Rulemaking Advisory Group (RAG) and a range of Thematic Advisory Groups (TAGs) supported the detailed technical work along with a Safety Standards Consultative Committee (SSCC) and its Subcommittees. The SSCC, which provided advice on strategic rulemaking issues, comprised members from organisations, associations and companies representing those industries, professions and end user groups subject to the Basic Regulation, the implementing rules, certification specifications or guidance material.

The December decisions of the EASA MB established a new advisory body structure that reflected the restructuring of the Agency in 2014 and the establishment of a new Safety Risk Management process during 2015. Two higher-level advisory bodies have been created, with the changes to be implemented in the course of 2016: a Member States Advisory Body (MAB) and a Stakeholder Advisory Body (SAB).

The role of the MAB is to consult Member States on opinions, certification specifications, acceptable means of compliance and guidance material to be applied by them. The MAB is also responsible for providing advice to the Agency on: the content, priorities and execution of its safety programmes; strategic developments; and implementation and standardisation issues of strategic or horizontal nature (including high-level, cross-domain implementation policies, such as the policy on acceptance of industry standards). MAB membership is restricted to representatives of the national competent authorities responsible for applying the Basic Regulation and its implementing rules (such as the CAA), and the European Commission. The SAB role largely mirrors that of the MAB but its membership will reflect a wider representation from industry. More detail on the roles of both bodies can be found in the relevant EASA Management Board Decisions (Nos 19-2015 and 20-2015 respectively) available on the EASA website[1].

Supporting the MAB will be seven Technical Bodies (TeBs) that will focus on specific areas of interest:

- Aerodromes (ADR TeB);
- Air Traffic Management/Air Navigation Services (ATM ANS TeB);
- Air Crew TeB;
- Air Operations (Air OPS TeB);
- Production and Continuing Airworthiness (P & CA TeB);
- General Aviation (GA TeB) and
- Safety Management (SM TeB).

The TeBs are a forum for consulting Member States on implementation issues and best practices as well as on technical safety priorities when the proposed actions (e.g. issuing safety promotion material or changing existing rules) affect the Member States. The TeBs will provide advice, through the MAB, on the content, priorities and execution of the Agency's safety programmes as well as on the best way to address safety initiatives such as safety promotion, focused oversight, regulations development, or research. The TeBs will also comment on preliminary impact assessments, rulemaking impact assessments and terms of reference for rulemaking and safety promotion projects, and will be the conduit for developing and providing economic and quantitative data on which the various assessments will be based.

There will be a parallel system of Stakeholder Technical Bodies (STeBs) to support the work of the SAB - this will be important in ensuring that appropriate technical advice is provided to the SAB, as some SAB members who represent trade associations may have limited personal experience of operations. Arrangements are also being developed to allow for joint TeB, MAB/TeB, and joint TeB/STeB, working on areas of common or overlapping interests.

Steps European Safety Risk Management Process	Key Tasks	Advisory Bodies and Technical Groups
Identify safety issues	Suggest candidate safety issues	**CAG** (Collaboration and Analysis Group)
Risk Assessment	Review the European Safety Risk Portfolio (SRP) from operational/ practical perspective Support safety analysis and risk assessment of safety issues for the SRP Propose candidate issues and candidate actions.	
Deciding on mitigation	*Discuss priorities and strategic orientation* Review and discuss strategic orientation Review and discuss structure and priorities of the RMP and EPAS Propose members for safety promotion tasks groups	**SAB** (Stakeholder Strategic Body)
	Discuss concrete actions Review and commit to concrete actions addressing safety issues (e.g. lithium batteries). *Propose members for safety promotion task groups* Approve the composition of Safety Promotion Task (SPT) groups. Approve the material developed in task groups.	**STeB** (Stakeholders Technical Body)
Implementation (Safety promotion)	*Develop Safety Promotion material* Develop or edit safety promotion material on specific issues (e.g. lithium batteries). Limited duration. Scope defined by TeB/STeB. Lead can be with EASA or NAA or Industry/Community.	**Safety Promotion Task (SPT) groups**
	Suggests and provides subject matter experts for the SPT groups. *Best-practice review and dissemination of safety promotion material* Communicate and disseminate safety promotion material. Comment on safety promotion products produced by the SPT groups Provide experts for safety promotion tasks.	**Safety Promotion Network**

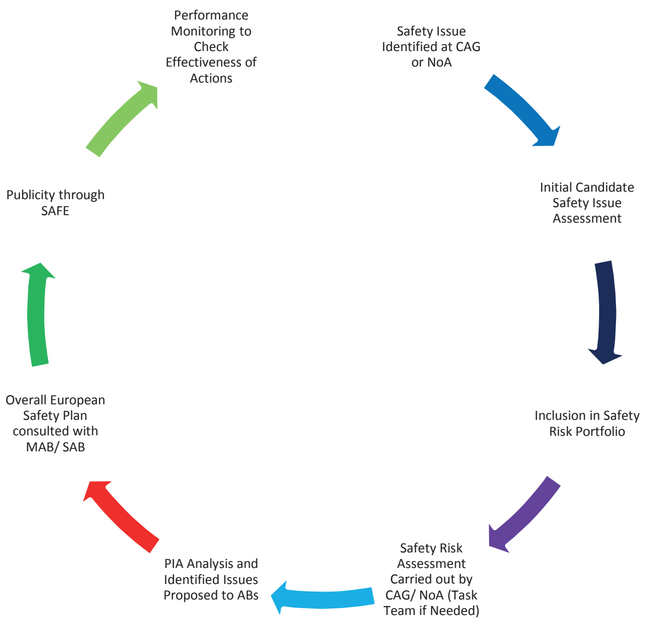
Table 1: The role of advisory bodies in European safety risk management – safety promotion focus

European Strategic Safety Initiative

Launched in 2006, the European Strategic Safety Initiative (ESSI) is an aviation safety partnership between EASA, other regulators and the industry. Consisting of the European Commercial Aviation Safety Team (ECAST), the European General Aviation Safety Team (EGAST) and the European Helicopter Safety Team (EHEST), the main task of ESSI has been to enhance safety through the production and dissemination of a wide range of safety promotion deliverables. The UKFSC has been a full participant in ECAST.

In 2015, The Agency implemented a Safety Risk Management (SRM) process. The SRM process includes: (1) Identification of Safety Issues, (2) Assessment of Safety Issues, (3) Definition and Programming of Safety Actions, (4) Implementation and follow-up of the actions and (5) the Measurement of the performance of the safety actions. The ESSI teams were involved in all the SRM key steps but the teams were working to certain degree in isolation from the activities of the Agency as well as other activities by Member States and the Industry. At the same time overlaps existed to the advisory bodies (formerly RAG/SSCC) and it became apparent that some degree of streamlining was required to increase the efficiency and effectiveness of the consultation process.

It has therefore been decided that the ESSI work would be merged with the new advisory body system, principally by establishing new Collaborative Analysis Groups (CAGs) that would draw on the expertise and membership of the existing ESSI teams. These CAGs will receive data from the Member States Network of Analysts (NoA) as part of the process to identify safety risks and emerging safety issues, and will help to align and integrate the identified risks and issues with the European Safety Risk Portfolio. The CAGs will be approximately 25-strong and will be domain-specific; the UKFSC has been invited to participate in the CAT CAG.

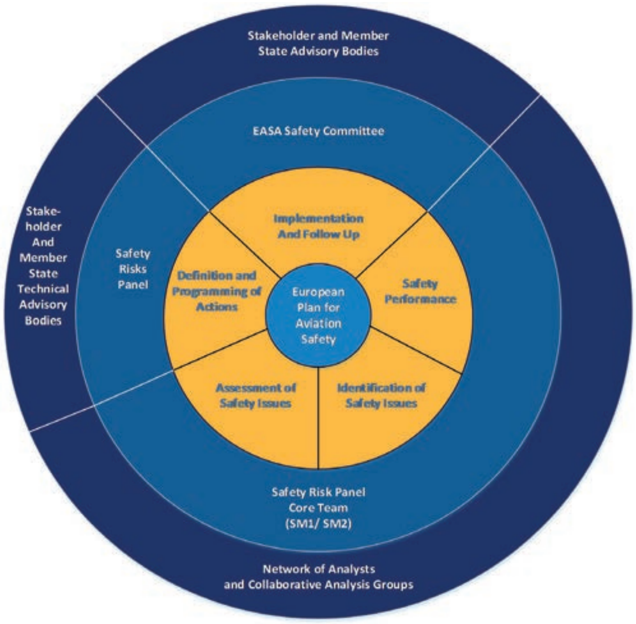


The Safety Risk Management Process

As the ESSI teams only had limited NAA participation, EASA is creating a Safety Promotion Network which aims to ensure that material is shared and disseminated among all Member States. Consisting of NAA SP professionals, the network's activities will include sharing material produced at national level, reviewing and agreeing dissemination actions for Safety Promotion material produced at EU level.

Safety promotion is being given much greater prominence than hitherto, and will become a recognised instrument to address safety risks alongside Rulemaking and Oversight. Where possible, safety promotion will be used instead of regulation, via the use of safety notices, recommendations and other material to promote best practice. Clearly, regulation will still be necessary for some issues but safety promotion activities will be used to bridge the time gap between identification of an issue and completion of any associated Rulemaking task. Based on a common Safety Risk Portfolio (SRP), the safety promotion and rulemaking programmes will be developed in a consistent manner as integral part of the European Plan for Aviation Safety (EPAS).[2]

For the other ESSI elements, no sub-SSCC helicopter-specialist committee existed previously and so a new STeB (Helicopter) will be created, based on the current EHEST core team. There will also be a rotary CAG to support its efforts. The membership and business overlaps between the old Sub-SSCC GA and the EGAST core team will be addressed by a merged grouping that will allow a GA CAG to support the GA STeB. As outlined above, the ECAST work will divide between the STeBs and the CAT CAG.



This schematic shows how the various elements of the new EASA safety structure will combine to produce a coherent and actionable European Plan for Aviation Safety.

It will be some time before the new working arrangements reach full capacity and some further revisions of the process may be required in future. The advisory bodies will have a key role to play in ensuring that EASA only regulates when necessary, and that safety promotion activities are coordinated and used appropriately. It will be incumbent on EASA to heed the advice developed by the Member State and Stakeholder Advisory Bodies; it will also be incumbent on industry to continue to support the collaborative approach now being developed.

Notes

1 https://www.easa.europa.eu/the-agency/management-board/decisions/easa-mb-decision-19-2015-ms-advisory-body-mab and https://www.easa.europa.eu/the-agency/management-board/decisions/easa-mb-decision-20-2015-stakeholder-advisory-body-sab

2 Formerly called the European Aviation Safety plan (EASp).

Showing the way

By Linda Werfelman

Researchers are examining ways of using internationally recognized symbols to aid in airplane evacuations.

Conflicting interpretations of the symbols that are used to show airline passengers how to leave the aircraft in case of an emergency could create a "deadly scenario," researchers say.[1]

In a report released in August by the U.S. Federal Aviation Administration (FAA) Civil Aerospace Medical Institute (CAMI), FAA researchers examined wayfinding — the technology of communication about paths of travel by using "various active and passive[2] modes of communication, such as lights, tactile objects, audio signals and computer-based technology to include virtual environments and augmented reality" — to identify the best ways to use internationally recognized symbols to indicate an escape path.

"This is proving to be difficult due to the meanings one culture places on certain symbols and how those differ among cultures," the researchers said in the report, titled *Wayfinding Technology and Its Application to Transport Category Passenger Airplanes*. "In an era of worldwide travel, this could create a deadly scenario as a passenger is attempting to egress from an aircraft in a dangerous situation, such as a fire, and misinterprets the available wayfinding symbology."

They added that their eventual goal is to limit the misinterpretation of wayfinding signals.

Wayfinding is one aspect of all human travel, the researchers said, and includes such elements as the layout of routes that people navigate — from forest pathways and building hallways, to roads between cities, and airplane egress routes. Wayfinding technologies include the "signs, symbols and signals people use to orient themselves," the report said, pointing to roadway markers and directional signs as well as placards and exit signs.

"In sum, wayfinding may be seen as a dynamic interaction of humans and technology that, because of the increasing number of travelers and expansion of the number and types of vehicles and potential destinations, demands an ever-growing array of information and presentation technology to yield a safe and successful journey."

In the United States, the need for wayfinding assistance for passengers involved in transport aircraft emergencies was recognized in the 1950s, when the Civil Aeronautics Board, a precursor to the FAA, began requiring exit signs that were lighted by a source independent of the aircraft's main electrical system.

"Since that time, numerous emergency occurrences and advances in technology [have] prompted the development of improved methods and materials to support wayfinding," the report said.

The report noted that in aircraft emergencies, passengers rely primarily on their vision to find a way out of the aircraft; however, vision usually is the first sense to be impaired by smoke and fumes. Earlier research determined that when that impairment occurs, individuals can lose up to 83 percent of their wayfinding ability.

"In such situations, normal vision must be augmented by wayfinding technology or vision 'substitutions' in order for passengers to navigate the dangerous situation and effect rapid evacuation," the report said. "The sensory information … to support these activities is available from a variety of sources and wayfinding technology."

Emergency Lighting

An aircraft's emergency lighting system provides the primary support for wayfinding during an emergency, and U.S. Federal Aviation Regulations Part 25.812 requires that aircraft with more than 10 passenger seats be equipped with "emergency lighting independent of the main lighting system, floor proximity escape path marking, illuminated emergency exit marking and locating signs and exterior emergency lighting."

In addition, Part 25.811 calls for transport category airplanes to have some method of helping occupants locate the exits in case of dense smoke. Because visibility beneath the smoke layer typically is not impaired, floor proximity escape path marking is designed to "provide evacuation guidance for passengers when all sources of illumination more than 4 ft [1 m] above the floor are obscured by dense smoke, enabling passengers to visually identify the escape path and each exit, relying solely on the markings and visual features that are less than 4 ft above the cabin floor," the report said.

The FAA has approved a number of combinations of lighting — including flood lighting, markers, signs and reflective materials — that meet its performance requirements for that purpose, the report said.

Among the active lighting systems,[2] earlier research identified several drawbacks to using incandescent lamps, including their relatively high power needs and their susceptibility to damage from vibration. Light-emitting diodes (LEDs) use less power, last longer and are less susceptible to vibrationrelated damage. Incandescent bulbs and LEDs both have been used in "pulsed and chasing light systems … that give the illusion of movement to indicate the direction to an emergency exit," the report said.

However, researchers concluded in the 1970s that most participants in research experiments involving the pulsed systems "would not follow the directional cues, unless instructed to do so, heading instead in the direction of the door by which they had entered the cabin." When spoken instructions accompanied the pulsed lighting, the number of wrong turns made en route to an exit decreased, and the time required to prepare the exit was reduced by more than 50 percent, the report said.

Electroluminescent lamps,[3] typically used in flexible plastic strips, are visible in smoky conditions and withstand shock and vibration — qualities that suit them for use in escape path marking, the report said.

In recent years, changes in active lighting systems have increased their reliability, the report said. Nevertheless, the document added that advances in passive lighting, especially those using photo-reactive materials, have boosted their popularity in transport airplane exit marking systems.

Glow-in-the-Dark Technology

Photoluminescent materials — those that absorb light energy from their surroundings and release the stored energy later, typically when other sources of light are unavailable because of a power failure — can provide escape path lighting for up to 16 hours. In most cases, they are installed on the cabin floor as narrow strips of photoluminescent material; they are charged by their exposure to cabin lighting and natural light that enters the cabin when window shades are open and discharged later, in the form of glow-in-the-dark strips along the cabin aisle. Usually they are installed as single strips that change color at the overwing exit rows and that turn toward the opening at floor-level exits; and they are paired with lighted signs installed at heights of less than 4 ft at each exit.

'Green Man Running'

Exit signs are the primary tool for notifying passengers of where to exit an airplane in an emergency, and regulations are intended to ensure that they are recognizable from a distance corresponding to the width of an airplane cabin. These signs often include the word "EXIT" in English and in another language, or the addition or substitution of symbolic exit signage, such as the "green man running," the report said.

"The intent is to provide language-independent signage identifiable across cultures throughout the international aviation domain."

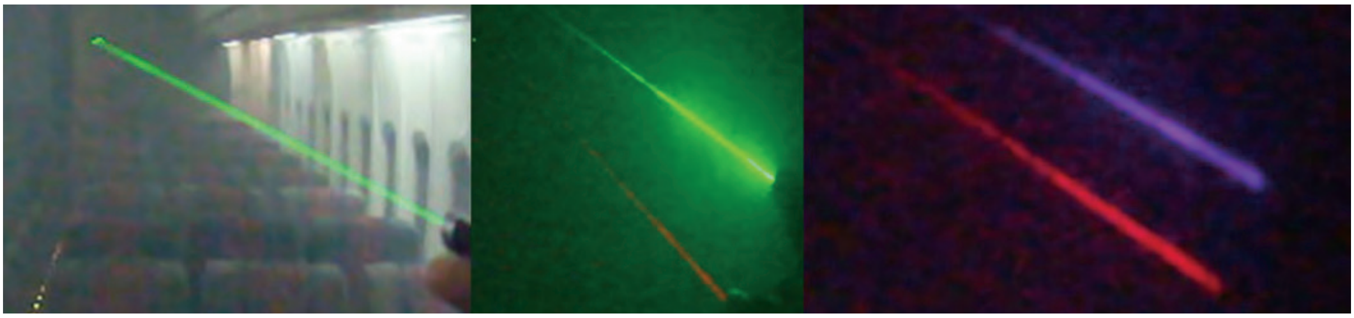
Earlier studies found that graphics such as the green man running "are more easily understood by the aviation industry professionals who created them, whereas the naïve passenger, for whom the information is intended, has a lower level of comprehension," the report said. "These findings highlight potential limitations with using novel representations to convey wayfinding (and other safety) information (i.e., making sure that the intended users are provided information they can understand, which may require that the information is paired with other displays or augmented by training and/or repeated experience)."

When symbols such as the green man running were accompanied by specific passenger briefings and descriptive information on a safety briefing card, the result was a level of safety equivalent to that of the "EXIT" sign, the report said.

The document cited research examining motorists' reactions to the recent trend of adding LEDs to other signs to "take advantage of the attention-grabbing aspect of flashing lights." The addition of the flashing lights increases sign conspicuity but also makes the signs more difficult to read, the research concluded. Airplane escape path marking systems do not use flashing lights on markings or locator signs, the report said.

Minimal Changes

Because regulations prescribe the requirements for lighting, signage and escape path marking systems, other technologies, including



the green man running, have been permitted only if they can be certified as providing an equivalent level of safety, the report said.

"As such, unique or novel technological innovations have often gone wanting when it comes to certification for use aboard transport category airplanes, resulting in a state of the art that has only changed minimally over the last few decades," the report added. "The advent of escape path marking systems in the 1980s was the last major advancement, with subsequent changes from incandescent bulbs to LEDs and red 'EXIT' signs to the green man running symbolic signs representing minor evolutions in on-board wayfinding aids for passengers."

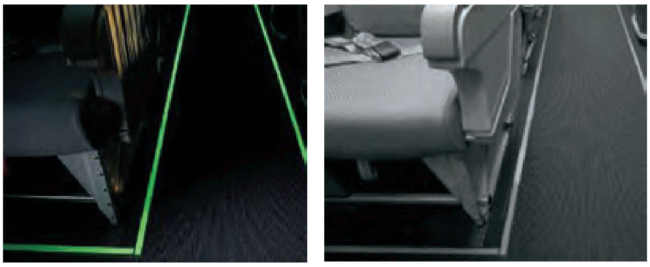
In recent years, new wayfinding technologies have developed, with "various implementations … [that] offer a range of approaches now familiar to anyone with a computer, smart phone or interactive electronic gaming device," the report said.

Although these new methods — including laser technology, virtual environments and augmented reality — have many advantages, not all are appropriate for use in transport category airplanes, the report said. For example, it noted that while laser beams become brighter as smoke becomes thicker, the beams also present hazards to vision that make it unlikely that they will be used to provide escape path guidance; and while augmented reality has been used in head-up displays and other systems to improve navigation, its use in transport category airplanes would require large investments.

In earlier research, combining existing escape path lighting systems with auditory warnings — in the form of human-like voices calling "exit here" or "this way out" — improved evacuation times, but scientists have found no reliable way to "tune" the wayfinding system logic to identify an exit that has become unusable and then to direct passengers to another exit, the report said.

Paying Attention

Overall, however, research has shown that passenger knowledge is crucial in determining how quickly and safely a passenger evacuates from an airplane in an emergency.



"The airplane passenger who has paid attention to the safety information available, who is familiar with the configuration of the airplane cabin and who has developed a plan for what he or she would do to get out of the airplane in a hurry would be better able to handle an emergency situation and would be better prepared to utilize the wayfinding system that has been provided for safe and rapid evacuation," the report said.

This is one area in which virtual environments, augmented reality, "serious games" (simulations of real-world scenarios that have been designed to train individuals, not simply to provide entertainment) and related technologies have potential, the report said, noting that they "present a most promising means to overcome the challenges of passenger apathy and to promote passenger safety awareness, knowledge and survival skills."

Notes

1. Paskoff, Lawrence N.; Weed, David B.; Corbett, Cynthia N.; McLean, Garnet A. DOT/FAA/AM-15/14, *Wayfinding Technology and Its Application to Transport Category Passenger Airplanes*. August 2015. Available at <www.faa.gov/go/oamtechreports>.

2. *Active* lighting systems are those that require a power source to provide illumination. Passive systems emit light energy collected from their surroundings and require no other power source.

3. The report describes electroluminescent lamps as being "made up of flat conductors and a layer of dialectric-phosphor that emits a field of light, rather than a point source, when a high-voltage alternating current is applied across the conductors."

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