Safety Regulation Group

CAA PAPER 2011/03

CAA 'Significant Seven' Task Force Reports

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Annex A Summary of Joint CAA-Industry 'Significant Seven' Task Forces

Foreword

The CAA task force initiative was launched in June 2009 as an action from the 2009 Safety Conference to address the seven top safety risks identified by the CAA safety risk analysis process. This process is described in the *CAA 2009/11 Safety Plan (CAP 786)* and essentially combines analysis of worldwide fatal accidents carried out by the CAA Accident Analysis Group (AAG) with more detailed analysis of high-severity occurrences to UK aircraft carried out by The High Risk Events Analysis Team (THREAT).

Five new task forces were created: Airborne and Post-Crash Fire, Airborne Conflict, Runway Overrun or Excursion, Loss of Control and Controlled Flight into Terrain (CFIT). Existing working groups addressed the remaining two safety issues: the Runway Incursions Steering Group (RISG) covered Runway Incursion and Ground Collision, and the Ground Handling Operations Safety Team (GHOST) covered Ramp Incidents.

Significant work was already underway or complete for several of the task force subjects (e.g. loading issues progressed by GHOST, runway incursion issues covered by RISG and airspace safety issues covered by the Airspace and Safety Initiative). The task forces were explicitly asked not to duplicate work but to identify where any additional safety intervention was required and to endorse, where appropriate, the continuation of existing work streams. A key feature of all task forces was the inclusion and active participation of the aviation industry.

This paper consolidates the findings and recommendations of the task forces into one document.

Annex A summarises the key output from each of the task forces and provides an update on progress made since the task forces reported their findings.

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Report 1 Loss of Control Task Force

Executive Summary

Loss of control has become one of the leading causes of fatal accidents during recent decades. Whilst technology has played a significant part in reducing some types of accidents, e.g. Controlled Flight Into Terrain (CFIT), there is some evidence that advances in technology and automation have increased the risk of loss of control events, or at least changed the risks involved.

The Loss of Control Task Force (LoCTF) drew on a broad spectrum of expertise from within the CAA, industry and other aviation organisations to review current literature, examine accident and serious occurrence data, brainstorm issues that may lead to loss of control and recommend actions to avoid or mitigate loss of control events in the future. The names of those who participated in the task force are listed in the appendix to this report.

As part of the literature review the task force considered and incorporated the relevant recommendations that were developed from the CAA SPI 2 Working Group.

Following a number of meetings and analysis of accident and serious incident data the following recommendations were agreed upon:

- Develop a separate and distinct loss of control Safety Performance Indicator (SPI).
- Develop type-specific Licence Skills Tests (LSTs).
- Extend the use of Alternate Training Qualification Programmes (ATQPs) to smaller operators.
- Enhance the manner in which automation is trained on complex and highly automated aircraft types.
- Set up an industry working group to consider how monitoring skills may be better trained and assessed.
- Enhance the current regulatory minimum requirements for a pilot undergoing a Multi-crew Pilot Licence (MPL) course.
- Promote training in the manual flying skills needed to recover from loss of control.
- Equip simulators with better data on aircraft handling characteristics when close to the edges of the flight envelope.
- Mandate the Jet Orientation Course (JOC) for all pilots who do not complete a MPL course, prior to their first complex and highly automated type rating.
- Improve the use of Flight Data Monitoring (FDM) data to help provide better understanding of the precursors to a loss of control event.

These recommendations are broadly split into two areas: those that need regulatory changes through EASA and those that can be acted upon by industry without a change in regulation.

On the regulatory side, the most pressing recommendation is the change to the LST. This will allow crews to be tested, and then regularly checked, against a set of skills that are more appropriate to the demands of a complex and highly automated type. A type-specific LST will replace the ‘one size fits all’ test schedule that is currently defined within JAR-FCL 1.

Outside of any regulatory change, the recommendation to form an industry working group to review how the skills associated with the monitoring role in the modern flight deck are trained and assessed is also considered a high priority. Currently, when testing and checking pilots’ competence, the principal focus is on their handling skills rather than their monitoring skills. However, safe operation of complex and highly automated aircraft relies on effective

monitoring of the aircraft systems, automation and the other pilot's actions. The recent Turkish Airlines accident at Amsterdam illustrates how a lack of effective monitoring can lead to a catastrophic outcome.

1 Terms of Reference

Scope

Initial analysis has identified three main causal categories for loss of control: technical, non-technical and icing. The task force analysis was confined to the flight crew non-technical category in public transport aircraft greater than 5,700 kg.

Purpose

To work with aircraft operators, training organisations and other stakeholders to establish the key risks that lead to loss of control, and to recommend strategies for monitoring and reducing these risks within a target acceptance level.

Key Tasks

- To perform a literature review of work already completed or underway in the area of loss of control, both at the CAA and externally.
- To undertake a systematic analysis of risks relating to loss of control.
- To develop training strategies for monitoring and reducing the key risks.
- In conjunction with Strategic Analysis, to develop a safety performance indicator to monitor the risks and to propose a target acceptance level.

2 Literature Review

The members of the task force reviewed the following documents:

Loss of Manual Flying Skills	Flight Operations Research Centre of Excellence (FORCE) (Cranfield University)
A study to develop a new methodology for automation training for the modern highly automated transport aircraft	S J Wood – FORCE (Cranfield University)
JSAT Loss of Control	CAST Approved Final Report, December 2000
The Interfaces Between Flightcrew and Modern Flight Deck Systems	FAA
Mode Awareness and Energy State Management Aspects of Flight Deck Automation	CAST
Pilot handling of highly automated aircraft	GAPAN
Do you really understand how trim works	Alex Fisher – GAPAN

3 Data Analysis

A key element of the task force's work was to review and analyse worldwide fatal accident and serious incident reports. The first task was to identify those accidents and serious incidents that featured loss of control as the main, or contributory cause of the event. The resultant set of reports was then analysed by mapping them against a number of possible remedial or mitigating actions that might lead to an avoidance of, or recovery from, a loss of control event. This analysis generated a ranking of the most significant actions; the ranking was used to help guide the task force towards recommendations that should be effective in reducing the risk of loss of control events.

When reviewing both the accident and the high-severity incidents there was, understandably, a great deal more detail available for the accident data than for the incident data.

The multidisciplinary team considered all 27 worldwide fatal accidents recorded by the CAA's Accident Analysis Group as involving loss of control. It then used their experience to indicate what areas needed improvement to reduce the probability of these accidents. These suggestions were grouped as shown below:

Manual Flying	Manual Flying Skills Training
	Manual Flying Skills Assessment and Recency
Automation	Automation Training
	Automation Design Issues
	Maintaining Control when Automation Drops Out
	Monitoring Skills
Type Related	Type Rating Training Syllabus
	Dealing with Non-Standard Aircraft Status or Configuration Errors
	Powerplant-inoperative Training
	Unstabilised Approach Recognition and Action
	Go-around Training
	Training by Simulation rather than in the Actual Aircraft
	Trim Considerations
Recovery Related	Upset Recovery Training
	Stall Prevention / Recovery Technology
	Attitude Perception
General Aspects	Human Factors Training
	Disregard of SOPs
	Counter-distraction Strategies
	Pilot Selection
	Fatigue Management

A survey of six team members was compiled to show which actions may have been, in their expert opinion, potentially beneficial in each accident. In essence this looked at the causes of the accident and/or a recovery/defence against escalation.

When reviewing the causes of the worldwide fatal accident data, where loss of control was identified as a factor, the following appeared in over 75% of them:

- Automation
- Type-related issues
- Manual flying skills
- General aspects – including Human Factors (HF)
- Upset recovery.

This is shown graphically below:

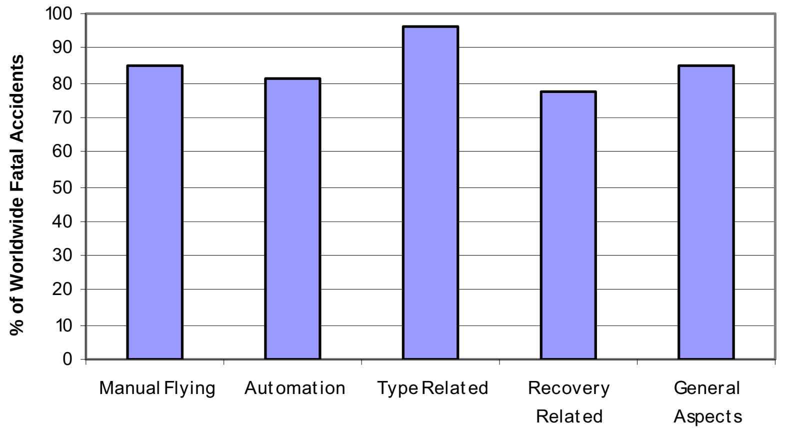

Figure 1 Worldwide Fatal Accidents – Cause / Remedial Action

The team next considered the 54 UK High-Severity Mandatory Occurrence Report (MOR) incidents – Grade A or B as defined by UK CAA – involving loss of control. The following appeared in more than 40% of them:

- Automation training
- Type-related issues
- Manual flying skills.

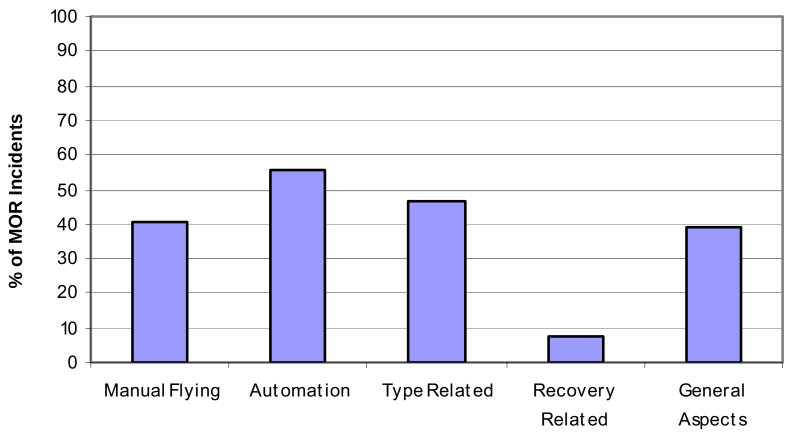

Figure 2 UK High-Severity Occurrences – Cause / Remedial Action

In addition, the team considered what had actually prevented the same set of incidents from escalating into accidents, and the results are shown below. For example, as all upsets had been successfully dealt with it was noted that in 85 percent of the cases the manual flying skills had been sufficient to save the day. This compares with some 40 percent of occurrences where they had been instrumental in getting into trouble.

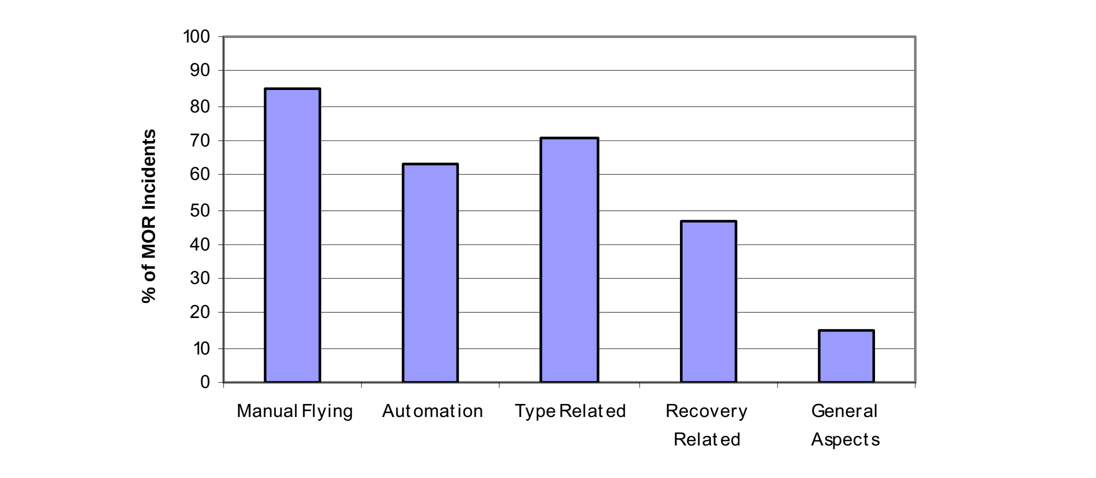

Figure 3 UK High-Severity Occurrences – Mitigation / Remedial Action

This aspect of causal versus mitigating factors needs further investigation as the above example indicates on the one hand that UK manual flying skills are saving the day, and on the other that on 40 percent of occasions they are causing the occurrence. Likewise, the differences between UK occurrences and worldwide fatal accidents may indicate a range of issues:-

- Strengths of the UK which mitigate against risks that result in fatal accidents elsewhere or the reverse, i.e. weaknesses.
- The difficulty in relating worldwide actions to those most beneficial to the UK.
- The potential difference between accidents and incidents and the difficulties in producing precursor measures from occurrence data.

Thought should be given to the coding of occurrences to better enable classification and factorising of records, ready for the production of even wider measures of risk. This is not possible from the current coding systems. Recommendation 1 below refers.

4 Recommendations

Recommendation 1: Loss of Control SPI

Risks to be mitigated:

There is currently no specific CAA SPI which looks at criteria that identify actual loss of control, events that are linked to loss of control, or precursors to a potential loss of control. This lack of an SPI may result in events linked to, or involved with, a loss of control event being missed due to the absence of data, or to limitations in the data recognition process.

Benefits:

A specific loss of control SPI will lead to an increased ability to identify and monitor trends regarding loss of control events.

Supporting Data:

Current limitations to the filters used in the analysis of MOR data for the identification of loss of control events have meant that it has been difficult to provide clear and definitive evidence to support this study. Additionally, the current analysis team does not, in all cases, have the appropriate training to recognise when loss of control is a factor in MOR reports.

Recommendations:

- An SPI be established which can be used to identify trends in MORs with respect to:
  - Evidence of actual loss of control using the unintentional conditions defined in the FAA *Airplane Upset Recovery Training Aid* manual.
  - Crew actions that indicate or suggest that the crew recognised a potential loss of control event was developing and that the actions taken prevented a loss of control event occurring.
  - Precursors to loss of control events.
- In conjunction with the above recommendation, the filters – particularly those relating to HF – used in the analysis of MORs need to be reviewed and, if necessary, modified to ensure that events in the above categories can be accurately identified. To facilitate this, it is recommended that additional fields are created within the MOR standard form to assist in identifying pertinent non-technical factors in the report.
- That a process of training be initiated to increase the standardisation of analysis undertaken.

This recommendation is complementary to Recommendation 10.

Recommendation 2: Type-Specific LST

Risk to be mitigated:

The current 'one size fits all' Multi-Pilot Aeroplane (MPA) LST makes little or no allowance for the wide variety in complexity of aircraft types, e.g. DC3 through to A380. A significant proportion of loss of control events has occurred due to inappropriate or incorrect use of automation by the crew. For modern transport aeroplanes type-specific automation elements are not required to be tested as part of a type rating.

The LST format defined under JAR-FCL is common to all multi-pilot aeroplane types. The format and content provide only very limited options for the skill test to check the pilot's competence in managing and operating the complex automation that is designed into modern transport aeroplanes.

Benefits:

A type-specific LST would require the training and testing to be directly linked to the skills required to operate the type safely. The syllabus defined by an 'evidence-based' approach and analysis of the specific type skill requirements would place an increased focus on the operation and management of the type's automation.

Supporting Data:

- The review of the accident and serious incident reports rated automation as a significant factor in the possible mitigation of loss of control events.

- The FORCE report – *A study to develop a new methodology for automation training for a modern highly automated transport aircraft* (January 2009) – concluded that *"The current regulations present an imbalance of emphasis in terms of the guidance provided for manual flying skill compared with the skill required for the correct management of automation."*
- Observation by CAA Training Inspectors provides anecdotal evidence that poor understanding of automation management leads to conditions that can lead to a loss of control condition.

Recommendations:

- EASA should change the content of the JAR-FCL LST by making it type specific for modern highly automated aeroplanes. The content of the LST should be determined by a process of consultation between EASA and the manufacturer. For future types and variants this would be completed as part of the Operational Evaluation Board (OEB) process during type certification. Aircraft manufacturers should always have an input to the content of type rating syllabi.
- Training manuals should include guidance on the use and management of the automation such that pilots can recognise, avoid, and ultimately recover from events that might lead to a loss of control condition. Additionally, information should be provided that identifies the risks associated with incorrect, or inappropriate use of automation and identify what can happen to the aircraft's flight path and energy through mismanagement of the aircraft's automation. At present, training manuals avoid mention of any potentially serious consequences – possibly to minimise exposure to litigation.

Recommendation 3: Extend the Accessibility of ATQP to Smaller Operators and those Utilising Mixed-Fleet Flying (MFF)

Risks to be mitigated:

Recurrent training that is predicated on the standard EU-OPS requirements allows only limited opportunities for the operator to develop training that is driven by experience and evidence-based data. The balance between the required training and the benefit to the operator is biased strongly towards the regulatory requirement.

An operator proposing an ATQP needs to satisfy a demanding regulatory requirement prior to its introduction. This regulatory requirement is such that currently, only major UK operators have the capacity to satisfy all the required elements and introduce a recurrent training programme that embraces the benefits of ATQP.

Benefits:

ATQP as defined by OPS 1.978 offers the operator the opportunity to develop a recurrent training programme that is bespoke and tailored to the operator's needs. The drivers for ATQP training are evidence based and include: training output, data from line operations, FDM programmes and operational risk assessment. Currently four UK operators are running ATQPs: British Airways, easyJet, Virgin Atlantic Airways and Thomson Airways.

ATQP has been unanimously hailed a great success by the UK airlines who have adopted it. It has been welcomed for its effectiveness by trainers and line crews alike, and has produced measured improvement in operating standards.

Supporting Data:

- Operator feedback following the introduction of ATQP.

- CAA Flight Operations Training Inspector observation and feedback provided by crews and trainers.

Recommendations:

- EASA in its regulatory role, and the CAA and other European National Aviation Authorities in their interpretation and implementation roles, introduce a process whereby medium- and small-sized operators are able to adopt ATQP.
- For the purposes of the implementation process (Appendix 1 to *EU-OPS1.978*), provision be made for smaller operators to:
  - Combine their task analyses for the definition of curricula, and make use of operators' collective data, data provided by the aircraft manufacturer and, where applicable, a third-party training provider.
  - Combine their feedback loops to validate the content of the curricula.
  - Use common methodologies for assessment of flight crew during conversion, and recurrent training and checking.
- EASA facilitate the adoption of ATQP by MFF operators. For example, because of the present requirement to hold a valid Licence Proficiency Check (LPC) on the relevant aircraft type(s), MFF operators (e.g. A320/330) who alternate LPCs on the two types at six-month intervals are unable to implement an ATQP programme without almost doubling the annual simulator time required by each crew member.

Recommendation 4: Enhanced Training of Automation

Risks to be mitigated:

The data from the analysis of the accident and high-severity occurrences identifies instances when the misuse, or inappropriate use, of automation has led, either directly or indirectly, to a loss of control condition.

Benefits:

A modified methodology for automation training in complex and highly automated aircraft would better equip pilots to identify and avoid loss of control situations. This training methodology would place an increased focus on the holistic use and management of the automation rather than training the individual functionality of it.

Supporting Data:

Data from the analysis of accident and serious incidents reports and the FORCE report on *Automation Training* (January 2009) evidences the shortcomings of the traditional approach to automation training. The conclusions of the FORCE report include: *"The training methodology developed during this research produced better performance in terms of automation management compared with classic training methods."*

Recommendations:

- UK operators should review their current syllabi for the training of automation, and explore how the style and content of this training may be modified to equip crews to operate complex and highly automated aircraft more effectively. The outcome would be subject to audit under the Flight Operations Inspectorate operator oversight programme.
- EASA should modify the Part FCL type rating syllabus and pilot check requirements for highly-automated aircraft types so that there is more focus on the use of

automation and, in particular, the use of a level of automation appropriate to each specific task. More emphasis is required during training on the use of lower levels of automation in appropriate circumstances, to avoid an 'automatics in or automatics out' culture. In the UK it would be possible to monitor the effectiveness of such changes through the Flight Operations Inspectorate operator oversight programme.

This recommendation is complementary to Recommendation 2.

Recommendation 5: Enhancement of Pilots' Monitoring Skills

Risks to be mitigated:

The evidence from the accident and high-severity occurrence reports highlights how inadequate monitoring by one or both pilots has been a causal or contributory factor in a number of loss of control events.

JAR-FCL requirements focus on the skills and knowledge of the operating pilot with only a very limited element of non-handling skills assessed.

Although EU-OPS places a greater and more balanced requirement on the skills of the crew as opposed to the individual through non-technical assessment and development, there is only limited and variable emphasis placed on the skills of monitoring.

Benefits:

With the advent of more complex and highly automated aircraft it is evident that the role of monitoring is becoming more critical. There is currently minimal guidance on the training and assessment of pilot monitoring skills. An increased focus on the monitoring role within a multi-crew flight deck could be expected to improve the likelihood of the recognition and avoidance of potential loss of control events.

Supporting Data:

- Analysis of accident and serious incidents reports.
- A brief, but illuminating, study by Thomson Airways using Eye Tracker analysis provides evidence of how a lack of skilled monitoring can lead to potential loss of control conditions.
- Evidence from observations by CAA Training Inspectors.

Recommendations:[1]

- Operators should adopt strategies for training effective monitoring skills.
- Pilots must develop techniques for monitoring the performance and behaviour of the other pilot, the operation of the aircraft (e.g. appropriate mode selections), the control of the flight path and aircraft energy, communications, task management, and situational awareness. Particular emphasis should be placed on the pilots checking that the autoflight systems are controlling the aircraft correctly. They must develop effective intervention strategies (when and how to intervene) and the concept of the three levels at which errors can be trapped: (1) avoidance by anticipation, (2) recognition before occurrence, and (3) early and effective mitigation.
- The CAA, or better still EASA, should establish a working group that draws on the training expertise from within the UK airline industry and other organisations to

1. See Priority Action (Section 6).

identify best practices in human flight deck monitoring and to propose training methods for the same. A possible output from such a group could be a DVD training aid to highlight awareness and suggest training strategies.

Recommendation 6: Enhancement of MPL Requirements

Risk to be mitigated:

The majority of course providers have elected to increase the flying hours content by approximately 25 hours (10 percent) over the current regulatory minimum. The focus of the additional training appears to be in the basic handling skills phase.

A pilot whose MPL course only satisfies the current minimum regulatory requirement (240 hours) may not be adequately prepared to undertake a type rating course on a complex and highly automated aircraft.

Benefits:

The regulatory requirements for the MPL course have not been changed since they were first introduced. Experience has demonstrated that additional training is necessary to achieve the required standard. The regulatory requirements need to be updated to ensure that what has proved necessary in practice is translated into a minimum requirement.

Supporting Data:

The regulatory requirements for the MPL course have not been changed since they were first specified in JAR-FCL 1 in December 2006.

The majority of course providers have elected to increase the flying hours content by approximately 25 hours (10 percent) over the current regulatory minimum. The focus of the additional training appears to be in the basic handling skills phase, and this is considered necessary to achieve the required standard.

Recommendation:

The minimum requirements specified in EASA Part FCL for the MPL course need to be increased to ensure that they equate to what has proved to be necessary in practice. This would be an example of good regulation following good practice.

Recommendation 7: Recovery from Loss of Control using Manual Flying Skills

Risks to be mitigated:

A lack of manual flying skill has been identified as a causal factor in a number of loss of control events that have led to an accident or serious occurrence. In particular it has been identified that this lack of manual flying skill becomes critical when the use of automation is either inappropriate or not possible. Situations will inevitably occur when only manual flying skills will be able to recover an aircraft from a situation that otherwise would become catastrophic.

Benefits:

In situations where a pilot has failed to avoid or recognise a chain of events that leads to a loss of control event it may be imperative for the pilot to possess the key manual flying skills necessary for recovery. These skills need to be taught and then practised on a regular basis so that they are maintained at an appropriate level.

Supporting Data:

- RAeS Upset Recovery study

- Accident and serious incident data analysis
- FORCE report regarding manual flying skills.

Recommendation:

Operators and training providers should ensure that initial training syllabi properly equip all pilots with the necessary level of manual flying skills, and that recurrent training syllabi enable these skill levels to be maintained.

This recommendation is complementary to Recommendations 2, 3, 6 and 8.

Recommendation 8: Flight Simulation

Risk to be mitigated:

Limitations in simulator fidelity could lead to pilots not having the manual flying skills required to recover from some loss of control scenarios. The flight envelope that is validated in a simulator is generally limited to the operating envelope expected during normal operations, and the problem areas are:

- Flight outside the certified envelope may provide negative training.
- Motion cues may be misleading and so may provide negative training.
- Pitch and roll attitudes that can be used are relatively limited.
- Behaviour at the stall and beyond is generally very benign giving pilots a false sense of security in this regime. This may result in negative training, for example:
  - The crew may become startled, and possibly confused by the aircraft behaviour during a real stall.
  - The crew develop an over-confidence in their ability to recover from a stalled condition.
  - The crew apply an incorrect recovery technique when their aircraft has become fully stalled.

Benefits:

Pilots will improve their ability to recover from loss of control events.

Supporting Data:

- Upset recovery research
- CAA Licensing and Training Standards Simulator Standards data.

Recommendations:

- EASA should mandate (1) upset recovery training for all pilots, and (2) a requirement for more extensive data at the edges of the specific aircraft's flight envelope (for example in the stall regime, where a wing may drop) to be incorporated in full flight simulators to facilitate such training.
- Operators should implement upset recovery training programmes for all pilots (there is currently no regulatory requirement in multi-pilot aeroplane training).

Recommendation 9: Mandating of JOC Training

Risk to be mitigated:

Pilots who gain their professional licence through a non-MPL route may not be adequately prepared for their initial multi-pilot type rating course, particularly when it is a complex and highly automated aircraft type. Pilots may not have some critical multi-crew foundation skills.

Benefits:

Pilots completing a non-MPL licence will be better equipped with the necessary foundation skills to operate more safely in a complex and highly automated aircraft.

Supporting data:

The FORCE report on automation training on modern highly automated aircraft.

Recommendation:

EASA Part FCL should mandate that pilots (other than holders of MPL) complete a JOC prior to commencement of their first type rating course on a highly automated jet aeroplane.

Recommendation 10: Improved Use of Flight Data Monitoring (FDM) Data by the CAA and Operators

Risks to be mitigated:

Missed opportunities to identify and address precursors to loss of control events. Loss of control events that might have been anticipated and prevented by optimised use of FDM analysis are more likely to occur.

Benefits:

By optimising the use of FDM data, operators' Safety Management Systems will identify risks, including loss of control, which can be countered by the modification of operating procedures and training content in order to improve safety.

This recommendation could be implemented with minimal cost and workload to the CAA.

Recommendations:

- Through their Safety Management processes, operators should use their FDM data to modify and refine the content of their pilot recurrent training programmes and to continually monitor the efficacy of these programmes – a 'continuous loop' principle.

  This recommendation is complementary to Recommendation 3 (Extend the accessibility of ATQP to smaller operators and those utilising MFF).

- Operators should consider the benefits of providing supporting relevant FDM data with MORs.
- CAA data analysis should be made available to industry.

5 Conclusions

In conjunction with Recommendation 7 (Recovery from Loss of Control using Manual Flying Skills), the CAA's Flight Crew Standards published a Flight Crew Training

Notice (*FCTN 01/10*) on 21 April 2010 to emphasise to instructors and examiners the appropriate stall recovery techniques to be taught; this has been widely read and well received.

The LoCTF considers that its work is now complete and accordingly the team has been disbanded. It has been apparent throughout that numerous projects on this topic are taking place in parallel, inevitably with duplication of effort and output. Significantly, the LoCTF understands that the European Commercial Aviation Safety Team (ECAST) has recently decided not to proceed with its own Loss of Control project for this reason. It is therefore proposed that the LoCTF should step back from the core work of implementing the recommendations, but shall be available to provide an oversight of actions being taken to ensure that the work being carried out is meeting the intent of the recommendations contained in this report.

6 Priority Action

It has been stressed elsewhere in this report that none of the recommendations it contains can be properly effective, and in some cases cannot even be implemented, in isolation: they are synergistic. Of the ten recommendations made, however, Recommendation 5 (Enhancement of Pilots' Monitoring Skills) as an initial action is considered to have the greatest potential for reducing loss of control events and, additionally, is attractive because it can be implemented in the UK without requiring EASA regulatory change.

Implementation proposal

Recommendation 5 states that: *"The CAA, or better still EASA, should establish a working group that draws on the training expertise within the UK airline industry and other organisations, to identify best practices in human flight deck monitoring and to propose training methods for the same. A possible output from such a group could be a DVD training aid to highlight awareness and suggest training strategies."* EASA, even if it were to accept the recommendation, would be unlikely to act upon it in the short term. Therefore, it is proposed that the task of setting up a working group from the UK aviation industry (**Phase 1** of this proposal) be allocated to the CAA Human Factors Programme Manager (who, incidentally, was a member of the LoCTF).

The output from this working group would lead to **Phase 2**:

"Operators should adopt strategies for training effective monitoring skills.

Pilots must develop techniques for monitoring the performance and behaviour of the other pilot, the operation of the aircraft (e.g. appropriate mode selections), the control of the flight path and aircraft energy, communications, task management, and situational awareness. Particular emphasis should be placed on the pilots checking that the autoflight systems are controlling the aircraft correctly. They must develop effective intervention strategies (when and how to intervene) and the concept of the three levels at which errors can be trapped: (1) avoidance by anticipation, (2) recognition before occurrence, and (3) early and effective mitigation."

Phase 3 would be continuous evaluation of the effectiveness of the process. Broadly, this would require two processes:

The first would be the analysis of AAIB reports and MOR data. The former are sufficiently few in number as to provide little benefit as a trend indicator. The latter can only be analysed effectively if the Loss of Control SPI process proposed in Recommendation 1 of this report, and enhanced by Recommendation 10, is implemented.

The second would be monitoring by the operator, logically through its Safety Management System. This, likewise, would require the implementation of Recommendation 10.

Timescale

Phase 1	
Working Group constituted. Terms of Reference and schedule agreed.	Month 0
Working Group output completed.	+ 12 months
Phase 2	
All UK Operators' Pilot Monitoring Skills Training Plans prepared.	+ 18 months
All pilots employed by UK AOC holders have received training in accordance with these plans.	+ 30 months
Phase 3	
The proposed LoC SPI (Recommendation 1) should be introduced as soon as possible. This would enable the new criteria to be used to establish a baseline of LoC data before Phase 2 commences, so that subsequent measurement of outcomes would be directly comparable.	As soon as Recommendation 1 of this report has been implemented.

Summary

The LoCTF recognises the need to train pilots in monitoring skills and techniques, but acknowledges that the expertise necessary to identify best practices and training strategies lies predominantly within the airline training industry and not the CAA. Hence, the proposal is that the CAA should coordinate a working group but not attempt to identify, autonomously, the solutions.

Good monitoring skills will undoubtedly become increasingly necessary with technological advances in aircraft automation systems.

It is considered that this Priority Action plan satisfies 'SMART' criteria.

The plan requires industry co-operation. However, there is already widespread interest in this area (e.g. Thomson Airways eye-tracker experiment) so this is likely to be forthcoming.

Implementation of the plan is not dependent on regulatory change or EASA involvement, although the latter would be highly desirable.

Appendix 1 Task Force Members

CAA Internal:

Capt. David McCorquodale	Head of Flight Crew Standards
Capt. Terry Buckland	FOI (Flight Crew Standards)
Capt. Terry Neale	FOI (Flight Crew Standards)
Capt. Andy Gaskell	FOI (Flight Crew Standards)
Capt. Ian Burns	FOI (Flight Crew Standards)
Capt. David Simmonds	FOI (Flight Crew Standards)

Capt. Steve Oddy	FCS Flight Examiner
Dr Robert Hunter	Head of Aeromedical Certification
Miss Rowan Christou	Strategic Analysis
Mr David Wright	Strategic Analysis
Mrs Sharon Read	Safety Data Unit

External:

Capt. Margaret Dean	Senior Inspector AAIB
Air Cdre Richard Jones CBE	Chief Executive, UK Flight Safety Committee
Capt. Simon Wood	FORCE
Wg Cdr Rupert Clark RAF	OC CFS Examining Wing
Flt Lt Chris Eccles RAF	CFS Multi-Engine Examiner
Capt. Alex Fisher	UK Flight Safety Committee
Mr Simon Grace	Thomas Cook Airlines
Mr Phil Luxton	Airbus Flight Safety Officer, Thomson Airways
Lt Cdr Jim Reed RN	MOD DARS

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Report 2 Runway Overrun or Excursion Task Force

Executive Summary

An action from the Safety Conference held in January 2009 was to form a joint CAA-industry task force to review the risk of runway excursions and formulate recommendations, which if implemented would mitigate the risk and identify Safety Performance Indicators (SPIs) to measure the effectiveness of the implemented recommendations.

The Runway Overrun or Excursion Task Force (ROETF), consisting of experts from the CAA, airline industry, aerodromes and NATS (see task force membership in Appendix 1) was formed in July 2009 to address the risk of runway excursions (see Terms of Reference for the task force in Appendix 2). The task force has met four times and liaised closely with representatives from Airlines, Air Traffic Service Providers and Safety Regulation Group (SRG) Flight Operations, Air Traffic Services and Licensing & Training Standards.

In all, the task force has made six recommendations which it feels if implemented, would further reduce the risk of a runway excursion both at UK aerodromes and aerodromes overseas involving UK AOC holders.

1 Introduction

1.1 The CAA uses a suite of SPIs to monitor the safety of the UK aviation industry of which one, SPI 2, relates to high-risk occurrences to UK public transport aircraft. This was one factor that prompted the CAA to organise a Safety Conference in January 2009 and an action from this conference was to form a joint CAA-industry working group to address the risk of runway excursions.

1.2 Runway excursions have been identified as one of a number of high risks to UK aviation through the work of The High Risk Events Analysis Team (THREAT). The task force was formed to address the risk of runway excursions both from the perspective of UK aerodromes and UK AOC holders that operate overseas.

1.3 The task force, consisting of experts from the CAA, airline industry, aerodromes and NATS, was formed to evaluate the causal factors (Appendix 3) associated with runway excursions and to identify and make recommendations to the CAA Safety Risks Team (SRT) aimed at reducing the risk of runway excursions in the future. The task force was also charged with identifying SPIs to measure the effectiveness of future initiatives and any mitigation measures that were implemented. The findings and recommendations from the task force would then be presented to the 2010 Safety Conference.

2 Analysis of Data

2.1 Fortunately, information was already available from CAA data (see Appendix 3).

2.2 The task force did not have specific airworthiness expertise and did not spend time analysing incidents linked to an aircraft technical malfunction/failure. That said, the task force found no coherent trend or pattern linked to aircraft technical malfunction/failure.

3 Methodology Used by the Task Force

3.1 At the first meeting the task force was briefed on the 'Significant Seven' and the work ahead. Data was also presented to ensure that the issues were focused on runway excursions and overruns. The task force then established their Terms of Reference and agreed to use generic data and event types to guide discussions. The discussion led to a list of issues that provided the agenda for subsequent meetings. The issues and the key discussion points are covered below.

4 The Issues

The task force agreed the following issues, and associated recommendations:

4.1 Review of Previous CAA Research

This research comprised the CAA Runway Excursion Fishbone exercise that was completed in June 2008. The following factors were identified by this work as the main areas that might lead to a runway excursion:

- flight handling (unstable approaches, high landing speed, touchdown point, handling during emergencies);
- timely crew decisions (very low-level go-arounds, late rejected takeoffs);
- technical failures (engines, thrust reversers, hydraulics, brakes, tyres);
- pilot information (weather, runway friction/ braking, late runway changes);
- runway/airport (reduced/unknown runway friction, runway end safety areas, runway markings and lighting, navigation equipment to promote stabilised approaches e.g. ILS);
- post-event management (evacuation, disembarked passenger management, communications, command and control);
- failure to appropriately train for realistic scenarios.

4.2 Review of Other Data

The task force has also reviewed a large amount of work completed by other organisations including:

- Flight Safety Foundation (FSF) Report of the Runway Safety Initiative;
- International Federation of Air Line Pilots' Associations (IFALPA) Runway Safety Manual;
- FSF Approach and Landing Accident Reduction Briefing Note 8.1 – Runway Excursions and Runway Overruns;
- CASA document – Minimising the Likelihood and Consequences of Runway Excursions, an Australian Perspective;
- Runway Excursions from a EUROCONTROL Perspective;
- Airbus – Runway Overrun Protection and Brake to Vacate Systems;
- Honeywell – Smart Runway and Smart Landing;
- UK AOC Holders.

4.3 Runway Excursion Problem

The runway excursion risk is complex due to the large number of variable factors involved. An excursion can be defined as either an overrun, where the aircraft overruns the end of the runway, or a veer-off, where the aircraft departs the side of the runway. As overruns and veer-offs can occur both on take-off and landing, four categories of excursion can be defined. Although some causal factors such as runway friction or weather affect each category, some are unique to a particular category. Also data shows that the type of aircraft, turbo prop or jet, is also a factor in the number of excursions in each category.

We can also group excursion factors into three main focus areas when we look at reducing the risk and potential harm from runway excursions:

- aircraft performance / pilot handling issues;
- runway friction/contamination;
- overrun/veer-off survivability.

4.3.1 Aircraft Performance / Pilot Handling Issues

It has long been recognised that a stabilised approach is key to reducing the risk of a runway excursion. Many excursions have originated from unstable approaches where the aircraft has an excess of energy at the 1,000 ft gate on the approach, resulting in a fast, hard or long touchdown. Pilot training, mentality and the decision to go-around are key areas that can be addressed by the airline industry.

4.3.2 Runway Friction/Contamination

Runway friction and contamination issues are other key areas that can be addressed by the task force. The capability for aerodrome operators to give meaningful data to pilots so that they can calculate stopping distances accurately and quickly is not yet possible. Other groups are heavily involved in this task including the ICAO Runway Friction Task Force and EASA Runway Friction and Braking Research Project (RuFAB).

4.3.3 Overrun/Veer-off Survivability

Many overruns result in severe damage to the aircraft and loss of life due to the inadequacy of safety areas surrounding the runway. ICAO Standards and Recommendations specify requirements for a Runway Strip and Runway End Safety Area (RESA) on each runway to provide a safe area for aircraft that veer-off or overrun the runway.

The UK CAA requires aerodromes to meet the standards and recommendations specified by ICAO. Aerodromes that cannot meet the standards or the recommendations are required to provide a safety case highlighting any mitigation measures in place.

4.4 Progress and Actions to Date

- The task force has had four successful meetings to date.
- Terms of Reference have been produced.
- Meeting held with IFALPA and ALPA INT'L.
- Meeting held with UK Flight Safety Committee.
- Meeting held with easyJet to review and discuss their work to date and their SMS.
- Presentation given to the RETRE Conference.

- Meeting with Flybe to discuss their approach with follow-up sessions in the flight simulator and actual line flying on the jump seat.
- Meeting with NetJets to discuss their approach with follow-up sessions in the flight simulator.

4.5 **Future Planned Actions**

- Further meeting with easyJet to review their simulator training.
- Continue to contribute to EUROCONTROL Runway Excursion Action Plan Working Group.
- Continue to contribute to ICAO Runway Friction Task Force.
- Meeting with Airbus to discuss and view new advanced technology in Runway Overrun Protection and Brake to Vacate.

5 Recommendations

5.1 **ROETF01 (Priority)**

The CAA should continue to support and promote the Revalidation Examiners of Type Rating Examiners (RETRE) system, RETRE and Type Rating Examiners (TRE) Newsletters and the current Flight Crew Training Notices (FCTNs) method of notification to industry trainers to further highlight the risk of runway excursions. This should include raising pilot awareness of the precursors to runway excursions (rushed approaches / long landings, etc.) and reinforcing effective SOPs through ATQP and LOFT training exercises. Further emphasis should be placed on all AOC holders through our Flight Ops Inspectors, in particular the "Dual Hatter Inspectors." It is apparent that small AOC holders may require additional direct support, guidance and advice from their Inspectors in relation to the prevention of runway excursions.

Rationale: The task force has liaised with a number of airlines to assess how they view the risk of runway excursions and how they train crews to avoid them through SOPs. The airlines assessed had all identified runway excursions as a high risk to their operations and had implemented training initiatives to address this. The CAA uses the RETRE system, RETRE and TRE Newsletters and the current FCTNs to highlight training issues. The task force believe that this method is effective and should be utilised wherever possible.

5.2 **ROETF02 (Priority)**

The CAA and industry should identify and promote appropriate precursors to runway excursions that AOC holders could use, from their flight data monitoring programmes, to set as SPIs to monitor the risk of a runway excursion. These precursors should be validated through analysis of flight data.

Rationale: The task force identified many precursors to runway excursions that could be found through airline flight data monitoring. These precursors could be used by airlines as SPIs and measured effectively. Appropriate changes to SOPs and pilot training to reduce the number of precursor events could be identified.

1. **Precursors for aircraft overrunning the end of the runway on landing (landing overrun)**

   Precursors could include: Long landing / high across threshold / extended flare / floating, incorrect performance calculation, ineffective use of stopping devices / time to apply reverse thrust or braking / inappropriate use of auto brake setting, weather related / runway condition / aquaplaning, unstabilised approach, tailwind landing.

2. **Precursors for aircraft veering off the side of the runway during landing (landing veer-off)**

   Precursors could include: Crosswind and wet /contaminated runway, hard landing / inappropriate use of stopping devices / asymmetric braking or reverse thrust, inappropriate use of nose wheel steering.

3. **Precursors for aircraft overrunning the end of the runway on take-off (take-off overrun)**

   Precursors could include: High speed aborted takeoff, incorrect performance calculation.

4. **Precursors for aircraft veering off the side of the runway during take-off (take-off veer-off)**

   Precursors could include: Crosswind and wet/contaminated runway, inappropriate use of nose wheel steering

5.3 **ROETF03 (Priority)**

It is recommended that the CAA, through the Safety Risk Management Process Project, conducts a review of safety data collection, coding and analysis to best establish and monitor the key risks to UK civil aviation and to track the success of associated recommendations. This review should:

- establish an appropriate risk classification scheme for mandatory occurrence reports (MORs);
- establish a multi-tiered structure of SPIs to monitor the key safety risks (high risk SPIs at the top and drilling down into lower-level precursors);
- identify alternative sources of safety data outside the scope of the MOR Scheme (e.g. FDM) to fill gaps in our safety knowledge;
- propose mechanisms for such data to be shared, with appropriate safeguards;
- propose a standardised set of measures, based on such data, for industry to monitor and report to the CAA (these measures would contribute the lowest level precursors to the key safety risks).

Rationale: There is a large amount of data collected by airlines that falls outside of the scope of the CAA's MOR scheme. This data, collected through flight data monitoring and safety occurrence reporting, could be used more effectively to reduce the risk of a runway excursion.

5.4 **ROETF04**

The CAA should continue to support runway excursion initiatives external to the CAA primarily driven by EUROCONTROL, Flight Safety Foundation and UK Flight Safety Committee. Flight Operations should lead involvement in these groups and where appropriate, should be supported by Aerodrome Standards and Air Traffic Standards.

Rationale: Other organisations are involved in addressing the risk of runway excursions. EUROCONTROL has a Working Group tasked with producing an Action Plan for the Prevention of Runway Excursions and it is important that there is harmonisation between the CAA and external Groups.

5.5 **ROETF05**

The CAA should continue to support efforts to standardise International and European (EASA) standards associated with both runway friction and aircraft braking action so that accurate, unambiguous and easy-to-use information is passed to flight crew to allow an accurate assessment of the braking action required.

Rationale: The ongoing problem of measuring and relating a runway friction value to an aircraft braking action needs to be resolved at international level.

5.6 **ROETF06**

Air Traffic Standards should review air traffic procedures and training processes to minimise air-traffic-induced rushed approaches such as late runway change, expedited approaches or speed limitations.

Rationale: The task force identified the need for a review of air traffic procedures to minimise air-traffic-induced rushed approaches and the need for a greater understanding of the issues surrounding unstabilised approaches from the air traffic controller's perspective.

6 Safety Performance Indicators

6.1 The following SPIs to measure the effectiveness of the recommendations are proposed by the Group. The SPIs are essentially high level and only measure actual events. Emphasis needs to be placed on recommendations ROETF02 and 03 to allow the CAA access to lower-level precursor information so that lower-level SPIs can be set in the future.

SPI 1: Worldwide overrun (including veer-off) of UK-registered aircraft during landing.

SPI 2: Worldwide overrun (including veer-off) of UK-registered aircraft during take-off.

SPI 3: Overrun (including veer-off) at UK aerodromes during landing.

SPI 4: Overrun (including veer-off) at UK aerodromes during take-off.

7 Communications

7.1 At this stage there are no direct issues related to external communications.

8 Conclusion and Recommendations

8.1 A summary of the recommendations is at Appendix 4.

Appendix 1 Task Force Membership

The task force is made up of the following members:

CAA Members:

Chris Farnaby	Chairman	Head AS Ops
James Eales		AS
Rowan Christou		SA
David Wright		SA
Roy Burden		PLD
Jonathan Nicholson		Press Office
Simon Williams		Flight Ops
Sharon Dean		SD
Sarah Lee		ATS

External Members:

Paul Davies	Bristol airport
Dave Whittington	Head Airside Ops, LHR
Simon Butterworth	Manchester airport
Mario Azevedo Moura	NetJets
Andy Taylor	NATS
Rob Holliday	Virgin Atlantic
Rod Young	British Airways
Miles Stapleton	GAPAN

Appendix 2 Task Force Terms of Reference

Introduction

The purpose, composition, functions and procedures of the task force are described below. The task force has responsibility for the revision and administration of these Terms, for SRT approval.

Working arrangements of the Task Force

Title: The group will be named the Runway Overrun or Excursion Task Force (ROETF)

Purpose

The main purpose of the task force is to evaluate the causal factors associated with excursions, recommend any Safety Initiatives and SPIs to the SRT and present their findings and recommendations to the 2010 Safety Conference with implementing criteria.

Key Tasks

- Perform a literature review of work already completed or underway in this area, both at the CAA and externally.
- Undertake a systematic analysis of risks relating to runway excursions, and create strategies for monitoring and reducing these risks.
- Develop SPIs, in conjunction with Strategic Analysis. The SPIs will need to be assessed against landings, take-offs, aerodromes, etc.

Membership

The Chairman and secretariat will be from SRG Aerodrome Standards. CAA experts from the following areas will be represented:

- Aerodrome Standards
- Flight Operations
- Airworthiness
- Air Traffic Standards
- Corporate Communications
- Research & Strategic Analysis

Industry representatives from the following organisations will be represented:

- UK Airlines
- Aerodrome Operators
- Air Traffic Providers

Meeting Frequency

- Initially two followed by relevant communications and/or meetings.

Deliverables and Timescales

December 2009	Report progress to SRT and EC
January 2010	Report progress to Safety Conference

Definition

"A Runway Excursion is defined as an aircraft inadvertently or uncontrollably leaving a runway end or side, usually during landing but also during take-offs, especially following a rejected take-off"

Records

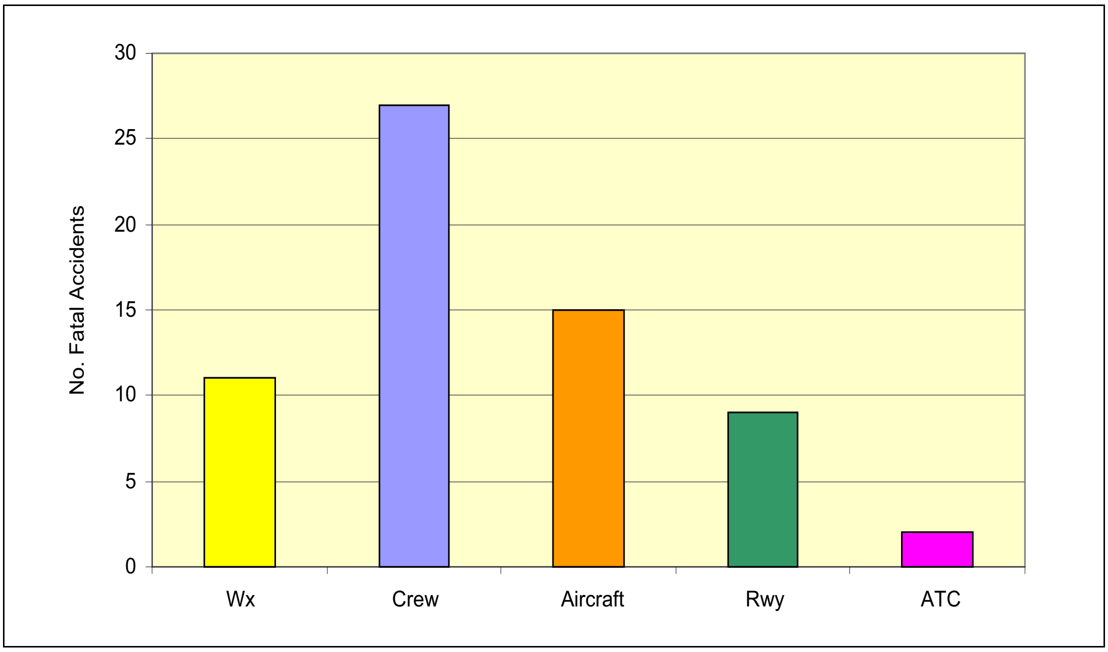
Meeting Notes and Actions: ERM (Secretary)

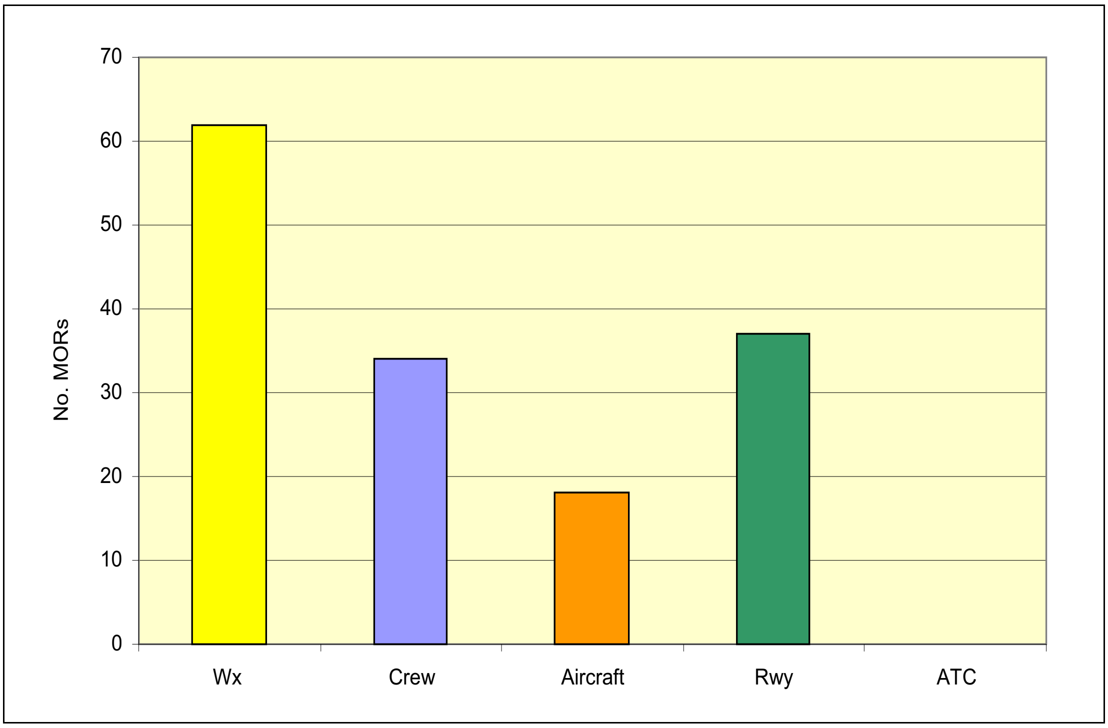
Internal Metrics: NR-STFT

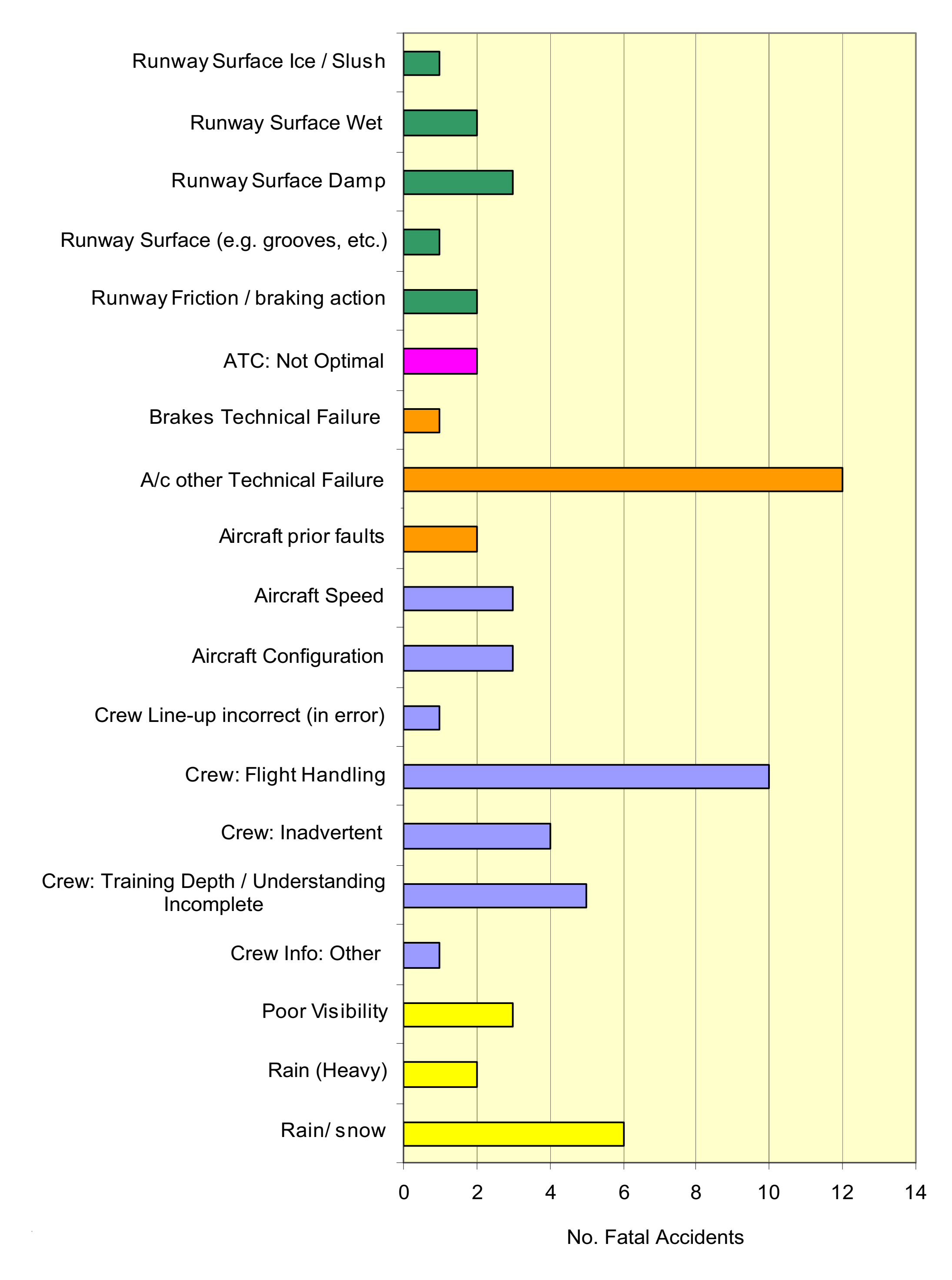
Chair and Secretariat

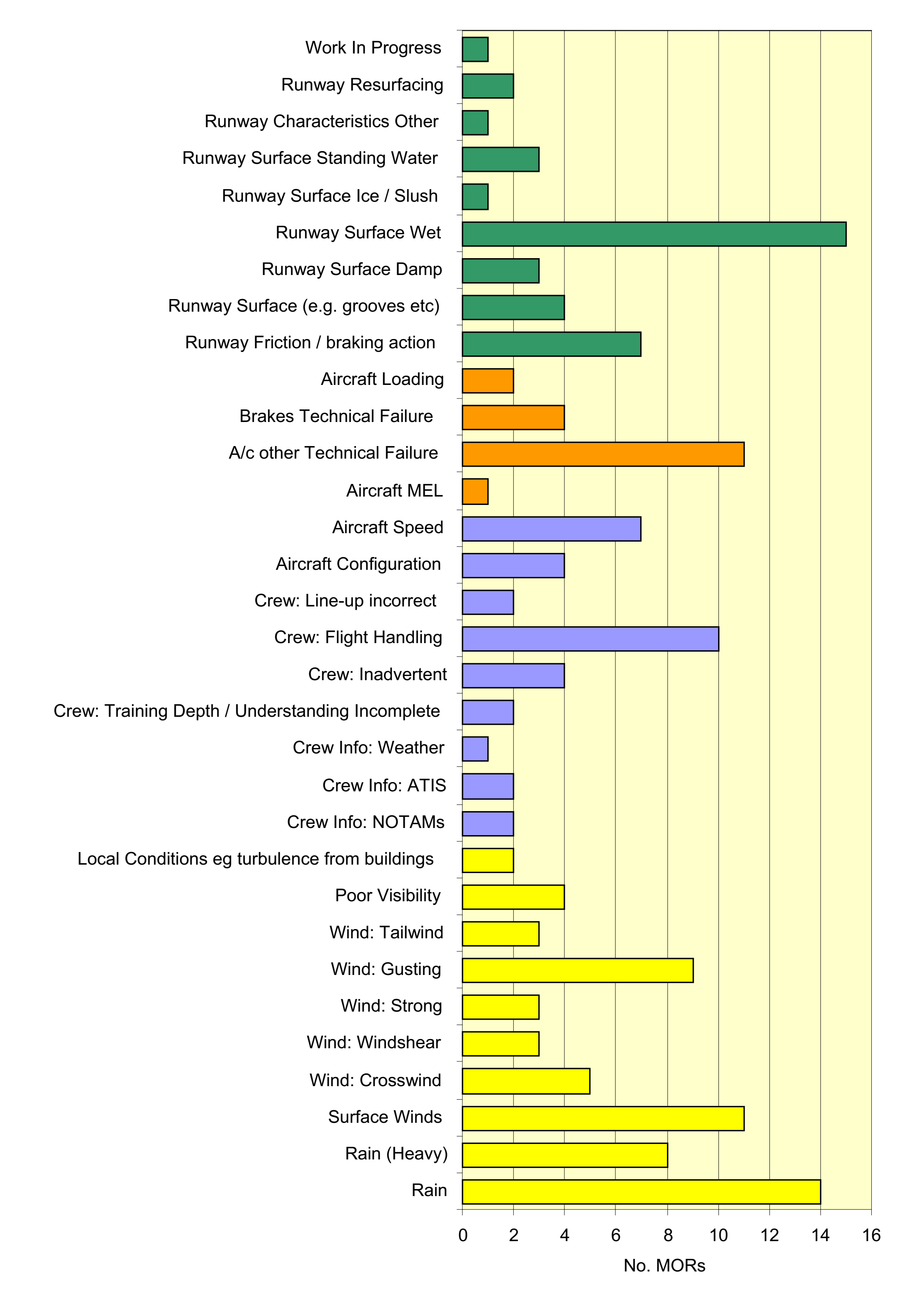
- Chris Farnaby (Chairman), Head of Operations, Aerodrome Standards
- James Eales (Secretary), Strategy and Standards Officer, Aerodrome Standards.

Appendix 3 Runway Excursion Analysis






Runway Surface Ice / Slush
Runway Surface Wet
Runway Surface Damp
Runway Surface (e.g. grooves, etc.)
Runway Friction / braking action
ATC: Not Optimal
Brakes Technical Failure
A/c other Technical Failure
Aircraft prior faults
Aircraft Speed
Aircraft Configuration
Crew Line-up incorrect (in error)
Crew: Flight Handling
Crew: Inadvertent
Crew: Training Depth / Understanding Incomplete
Crew Info: Other
Poor Visibility
Rain (Heavy)
Rain/ snow
0
2
4
6
8
10
12
14
No. Fatal Accidents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Runway Resurfacing
Runway Characteristics Other
Runway Surface Standing Water
Runway Surface Ice / Slush
Runway Surface Wet
Runway Surface Damp
Runway Surface (e.g. grooves etc)
Runway Friction / braking action
Aircraft Loading
Brakes Technical Failure
A/c other Technical Failure
Aircraft MEL
Aircraft Speed
Aircraft Configuration
Crew: Line-up incorrect
Crew: Flight Handling
Crew: Inadvertent
Crew: Training Depth / Understanding Incomplete
Crew Info: Weather
Crew Info: ATIS
Crew Info: NOTAMs
Local Conditions eg turbulence from buildings
Poor Visibility
Wind: Tailwind
Wind: Gusting
Wind: Strong
Wind: Windshear
Wind: Crosswind
Surface Winds
Rain (Heavy)
Rain
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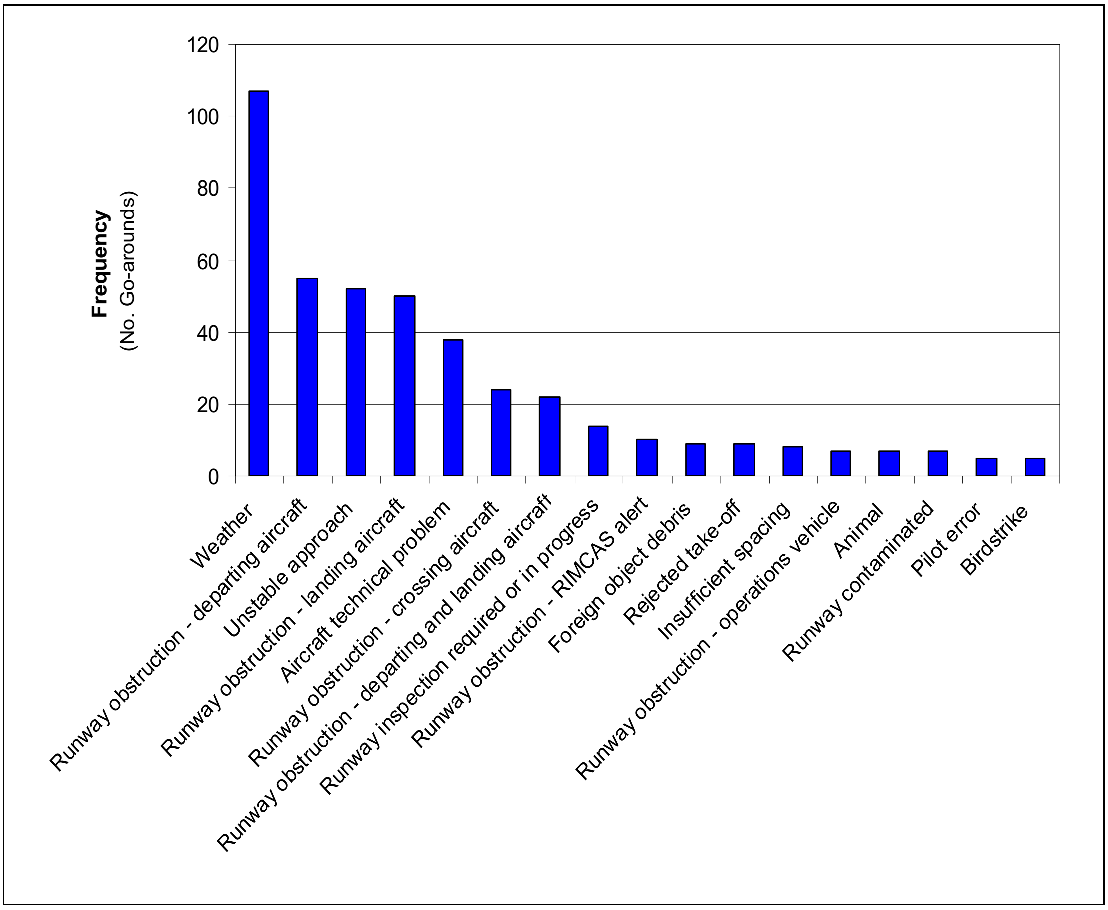
12
14
16
No. MORs


Frequency
(No. Go-arounds)
120
100
80
60
40
20
0
Weather
Runway obstruction - departing aircraft
Unstable approach
Runway obstruction - landing aircraft
Aircraft technical problem
Runway obstruction - crossing aircraft
Runway obstruction - departing and landing aircraft
Runway inspection required or in progress
Runway obstruction - RIMCAS alert
Foreign object debris
Rejected take-off
Insufficient spacing
Runway obstruction - operations vehicle
Animal
Runway contaminated
Pilot error
Birdstrike

Appendix 4 Recommendations

Task Force: *(use drop-down list)*

Runway Overrun or Excursion

Recommendation Reference (e.g. LoCTF01):

ROETF01

Recommendation Title:

The CAA should continue to support and promote the Revalidation Examiners of Type Rating Examiners (RETRE) system, RETRE and Type Rating Examiners (TRE) Newsletters and the current Flight Crew Training Notices (FCTNs) method of notification to industry trainers to further highlight the risk of runway excursions. This should include raising pilot awareness of the precursors to runway excursions (rushed approaches / long landings, etc.) and reinforcing effective SOPs through ATQP and LOFT training exercises. Further emphasis should be placed on all AOC holders through our Flight Ops Inspectors, in particular the "Dual Hatter Inspectors". It is apparent that small AOC holders may require additional direct support, guidance and advice from their Inspectors in relation to the prevention of runway excursions.

Recommendation Scope: *(tick all that apply)*

Regulatory Change ☐ Guidance Material ☒ Training ☒ Further Study/Research ☐

Procedural Change ☒ Technology ☐ Other

Addressee (e.g. CAA):	If CAA, then Proposed Recommendation Sponsor (CAA Business Area): ***(use drop-down list)***
CAA	Licensing & Training Standards

Justification:

Risk(s) to be Mitigated (both safety and business risks):

Runway excursions.

Risk(s) of not Implementing (both safety and business risks):

Reputational risk to CAA and precursors that are already known factors associated with excursions may not be highlighted to AOC holders.

Benefits:

Increased awareness associated with mitigating runway excursions and reinforcing the importance of effective SOPs and training systems within airlines.

Supporting Data:

Strong evidence based on direct observation through visits to various AOC holders including Flybe, easyJet and NetJets.

Task Force: *(use drop-down list)*

Runway Overrun or Excursion

Recommendation Reference (e.g. LoCTF01):

ROETF02

Recommendation Title:

The CAA and industry should identify and promote appropriate precursors to runway excursions that AOC holders could use, from their flight data monitoring, to set as safety performance indicators to monitor the risk of a runway excursion. These precursors should be validated through analysis of flight data.

Recommendation Scope: *(tick all that apply)*

Regulatory Change ☐ Guidance Material ☒ Training ☒ Further Study/Research ☐

Procedural Change ☐ Technology ☐ Other

Addressee (e.g. CAA):	If CAA, then Proposed Recommendation Sponsor (CAA Business Area): ***(use drop-down list)***
CAA	Group Safety Services

Justification:

Risk(s) to be Mitigated (both safety and business risks):

Runway excursion.

Risk(s) of not Implementing (both safety and business risks):

Relevant valuable data is not utilsed to reduce the risk of runway excursions.

Benefits:

Identified trends could be used to modify training and improve SOPs based on supporting data.

Supporting Data:

FDM data, held by airlines, contains valuable information on the precursors to runway excursion events that is not readily identifed by MOR information alone. The collection, sharing and use of this data is seen by the task force as critical in reducing the number of runway excursion events.

Task Force: *(use drop-down list)*

Runway Overrun or Excursion

Recommendation Reference (e.g. LoCTF01):

ROETF03

Recommendation Title:

It is recommended that the CAA, through the Safety Risk Management Process Project, conducts a review of safety data collection, coding and analysis to best establish and monitor the key risks to UK civil aviation and to track the success of associated recommendations. This review should:

- establish an appropriate risk classification scheme for mandatory occurrence reports (MORs);
- establish a multi-tiered structure of SPIs to monitor the key safety risks (high risk SPIs at the top and drilling down into lower-level precursors);
- identify alternative sources of safety data outside the scope of the MOR Scheme (e.g. FDM) to fill gaps in our safety knowledge;
- propose mechanisms for such data to be shared, with appropriate safeguards;
- propose a standardised set of measures, based on such data, for industry to monitor and report to the CAA (these measures would contribute the lowest-level precursors to the key safety risks).

Recommendation Scope: *(tick all that apply)*

Regulatory Change ☐ Guidance Material ☒ Training ☐ Further Study/Research ☒

Procedural Change ☒ Technology ☐ Other

Addressee (e.g. CAA):	If CAA, then Proposed Recommendation Sponsor (CAA Business Area): ***(use drop-down list)***
CAA	Group Safety Services

Justification:

Risk(s) to be Mitigated (both safety and business risks):

Runway excursion.

Risk(s) of not Implementing (both safety and business risks):

Benefits:

A more thorough use of all data associated with runway excursions.

Supporting Data:

FDM data has been identified as a useful source of data regarding precursors to runway excursion events.

Task Force: *(use drop-down list)*

Runway Overrun or Excursion

Recommendation Reference (e.g. LoCTF01):

ROETF04

Recommendation Title:

The CAA should continue to support runway excursion initiatives external to the CAA primarily driven by EUROCONTROL, Flight Safety Foundation and UK Flight Safety Committee. Flight Operations should lead involvement in these groups and where appropriate, should be supported by Aerodrome Standards and Air Traffic Standards.

Recommendation Scope: *(tick all that apply)*

Regulatory Change ☒ Guidance Material ☒ Training ☒ Further Study/Research ☒

Procedural Change ☒ Technology ☒ Other

Addressee (e.g. CAA):	If CAA, then Proposed Recommendation Sponsor (CAA Business Area): ***(use drop-down list)***
CAA	Flight Operations, Aerodrome Standards and Air Traffic Standards

Justification:

Risk(s) to be Mitigated (both safety and business risks):

Runway excursion.

Risk(s) of not Implementing (both safety and business risks):

Disjointed approach between CAA and external groups to reduce the risk of a runway excursion on a worldwide basis.

Benefits:

UK CAA involvement and direction.

Supporting Data:

Previous successful involvement with external groups (EUROCONTROL European Action Plan for the Prevention of Runway Incursions).

Task Force: *(use drop-down list)*

Runway Overrun or Excursion

Recommendation Reference (e.g. LoCTF01):

ROETF05

Recommendation Title:

The CAA should continue to support efforts to standardise International and European (EASA) standards associated with both runway friction and aircraft braking action so that accurate, unambiguous and easy-to-use information is passed to flight crew to allow an accurate assessment of the braking action required.

Recommendation Scope: *(tick all that apply)*

Regulatory Change ☒ Guidance Material ☒ Training ☐ Further Study/Research ☒

Procedural Change ☐ Technology ☐ Other

Addressee (e.g. CAA):	If CAA, then Proposed Recommendation Sponsor (CAA Business Area): ***(use drop-down list)***
CAA	Aerodrome Standards, Flight Operations and Licensing & Training Standards

Justification:

Risk(s) to be Mitigated (both safety and business risks):

Runway excursion.

Risk(s) of not Implementing (both safety and business risks):

Continued confusion between runway friction and aircraft braking action.

Benefits:

Will enable flight crew to accurately anticipate the braking action required on contaminated runways.

Supporting Data:

SRG is currently represented by Aerodrome Standards who participate in the ICAO Runway Friction Task Force and EASA Runway Friction and Braking Research Project (RuFAB) and liaise with other departments within SRG.

Task Force: *(use drop-down list)*

Runway Overrun or Excursion

Recommendation Reference (e.g. LoCTF01):

ROETF06

Recommendation Title:

Air Traffic Standards should review air traffic procedures and training processes to minimise air-traffic-induced rushed approaches such as late runway change, expedited approaches or speed limitations.

Recommendation Scope: *(tick all that apply)*

Regulatory Change ☒ Guidance Material ☒ Training ☒ Further Study/Research ☐

Procedural Change ☒ Technology ☐ Other

Addressee (e.g. CAA):	If CAA, then Proposed Recommendation Sponsor (CAA Business Area): ***(use drop-down list)***
CAA	Air Traffic Standards

Justification:

Risk(s) to be Mitigated (both safety and business risks):

Runway excursion.

Risk(s) of not Implementing (both safety and business risks):

Controllers could continue to contribute to a rushed and unstable approach.

Benefits:

Standardised operating procedures.

Supporting Data:

The task force has identified that ATC-induced rushed approaches are a contributory factor to runway excursions.

Report 3 Controlled Flight into Terrain Task Force

Executive Summary

An action from the Safety Conference held in January 2009 was to form joint CAA-industry working groups to identify why UK high-risk events were increasing and what could be done to remedy the situation. Seven 'task forces' were formed to address the top seven contributing factors; Controlled Flight into Terrain (CFIT) was one such task force, with members drawn from industry and the CAA.

The initial work carried out by the task force was to review a previous paper prepared by the CFIT Fishbone study group in 2005/2006. Progress with recommendations included in Safety Plans was investigated and is summarised in this report. Recommendations not accepted at that stage were reviewed. CFIT Standard Operating Procedures (SOPs) and training by small and large fixed-wing aeroplane and helicopter operators were compared. Correctly following a Terrain Awareness Warning System (TAWS) warning is an effective mitigation to CFIT. Precursors to CFIT incidents were examined with the assistance of industry. However, the Mandatory Occurrence Report (MOR) data relating to precursors is weak and other sources of information should be investigated. Improvements to existing, and advances with, technological solutions were explored.

An analysis of CFIT accidents and serious incidents is included. The worldwide CFIT fatality rate in the past 20 years has been relatively low. The major factors involved in fatal accidents and serious incidents are circling and non-precision approaches, loss of situational awareness and non-adherence to SOPs. The use of a Global Navigation Satellite System (GNSS) based position feed to TAWS greatly reduces the incidence of false warnings, and probably, the absence of valid warnings.

As far as it is known, there has only been one fatal CFIT accident to an aircraft with a functioning TAWS on board, and this was due to the crew ignoring the TAWS warning.

1 Discussion

CAA took the decision in July 2009 to form a series of task forces to study and provide risk reduction strategies for the seven most significant potential catastrophic outcomes, as determined by the work of the CAA's Accident Analysis Group (AAG) and The High Risk Events Analysis Team (THREAT), to large commercial air transport aircraft. These are defined as aircraft with a maximum take-off mass exceeding 5,700 kg.

Analysis of 57 worldwide fatal CFIT accidents, covering the ten-year period 1998 to 2007, indicated that a loss of situational awareness and poor CRM were major factors, often combined with an unstable approach. MOR data confirms this and poor radar vectoring by ATC can be added as an additional factor. Hence, additional pilot training concerning the recognition of the precursors to a CFIT incident is a recommendation.

The initial task was to select task force members from relevant CAA departments, and industry experts in the field, and to establish the terms of reference. These are set out in Appendix 1. Considerable effort was put into collating and analysing the considerable quantity of CFIT related material, involving the whole team. The report of the CFIT Fishbone study group in 2005, updated in 2008, was comprehensive and provided a sound starting point. Progress with the recommendations incorporated in the Safety Plans were updated and is included at the end of this section. The recommendations not included in the Safety Plans were given further consideration. The FAA CFIT and Crew Resource Management (CRM) training material was circulated for consideration.

The major fixed-wing operators have been very CFIT-aware for a long time, and have made maximum use of the available technology, so it was decided that areas of industry with less developed CFIT avoidance strategies should be involved. Hence, a business jet operator and a helicopter operator were invited to join the task force. This led to some interesting exchanges of information, with British Airways providing some useful training material. The business jet operators have very little opportunity for practical CFIT training due to the lack of readily available simulators, and mainly make use of briefings and awareness campaigns. Although some of the larger more complex helicopters are Enhanced Ground Proximity Warning System (EGPWS) equipped, operators appear to be uncertain how to implement its use. However, the helicopter environment is unique, in that many operations are to sites which are not aerodromes, and to rigs, some of which are mobile. The formation of a dedicated helicopter group to study the issue further is recommended.

A presentation on the work of the task force was presented at the Revalidation Examiner of Type Rating Examiners (RETRE) conference in November 2009.

A team from Honeywell attended the January 2010 meeting and gave a very informative presentation. They recommended that for optimum performance, the latest standard of EGPWS should be used, fed with Global Positioning System (GPS) derived position data. Also operators should ensure that they have the latest EGPWS database installed. There is no regulatory standard for electronic terrain and obstacle databases, and no regulatory requirement to ensure that they are amended.

A progress report was published in January 2010. Draft recommendations were circulated in February 2010 and examined, along with draft safety performance indicators (SPIs) at the April 2010 meeting. The recommendations and SPIs considered appropriate are included in this report.

New technology was considered.

1.1 Transponder Mode S

More use could be made of the information available from transponder Mode S downloads, such as ensuring that the crew are using the correct altimeter sub-scale setting. For non-precision and particularly barometric Area navigation (RNAV) approaches, using the correct altimeter setting is crucial. Also, all but the latest TAWS rely on barometric altitude to determine clearance from terrain. A NATS Research and Development paper published in March 2010 concluded that mis-setting the altimeter sub-scale was still a concern. An algorithm for an automated tool to detect an altimeter sub-scale error is in an advanced state; however, further analysis regarding implementation is required.

1.2 EGPWS/TAWS

As the availability of GPS and terrain databases has become common in all types of aircraft, so has basic TAWS in smaller aircraft. ICAO recommends the fitting of EGPWS and TAWS in large piston and small jet aircraft. Due to the increased availability and low cost of basic TAWS, a cost/benefit analysis should be carried out by EASA to determine whether specific capability should be a requirement for aircraft in these classes.

1.3 RNAV

Non-precision approaches have been shown to increase the CFIT risk. Recommendations from the original CFIT Fishbone study group included the introduction of more GNSS approaches and the provision of more training material, particularly for General Aviation (GA). The increased RNAV capability of all classes of aircraft in recent years reinforces the validity of this recommendation.

1.4 Minimum Safe Altitude Warning System

An investigation of technology currently available indicated that the Minimum Safe Altitude Warning (MSAW) system, which warns controllers if an aircraft deviates from the correct approach path, would have prevented some incidents/accidents had it been installed. Eurocontrol have carried out a considerable amount of work on the specification of a European system and an associated safety case. This work is ongoing.

2 Progress with Original CFIT-Related Actions Found in the Safety Plan (and Updates)

2.1 Undertake a cost/benefit analysis of SSR and/or other approach monitoring improvements

The CAA has undertaken a feasibility study and initial cost/benefit analysis into the provision of Secondary Surveillance Radar (SSR) and approach monitoring aids at significant UK airports. The results of the study showed that such a provision was likely to be technically unsustainable due to radio frequency congestion and of prohibitive cost, possibly running to over £100 million. As a result, no further effort will be spent on this study.

2.2 Complete the design and assessment work for the Gatwick 'Approach with Vertical Guidance' (APV) BaroVNAV trial

Following the successful completion of the APV Barometric Vertical Navigation (BaroVNAV) trial at Gatwick, the CAA has approved the use of 3-dimensional BaroVNAV procedures subject to certain conditions. Such approach procedures will only be authorised to suitable instrument runways, at appropriately equipped licensed aerodromes with Air Traffic Control (ATC) services. The standard CAA process will be followed for the design and publication of each individual procedure and the sponsor of each procedure will be required to provide a safety case to the CAA. APV BaroVNAV procedures for London Gatwick Runways 08R and 26L and London Heathrow 27L are published in *Aeronautical Information Package Supplement S34/2007*. The challenge will be to equip the northern runway with an RNAV (GNSS) Non-Precision Approach (NPA) to replace the Surveillance Radar Approach (SRA) 2.0 approach. It is the CAA 1560 (Declaration of Runway Declared Distances) that states 'Visual' as the primary issue. An assessment of the possibility to re-classify it as 'Instrument' may have to be undertaken.

2.3 Complete the design and assessment work for the six GNSS trial approaches

The trial of GNSS NPAs for GA aircraft at six UK airports ended on 31 December 2006. Issues that emerged included lack of familiarity with the equipment and the need for training. There was confusion over procedure representation and interpretation of distance to runway during the final approach. To date, three of the six airports have achieved approval for RNAV (GNSS) NPAs (Shoreham, Exeter and Gloucester). Two of the remainder withdrew after the trial and have not proceeded (Durham Tees Valley and Inverness) and the current status of Blackpool's application is unknown.

2.4 **Publish the results of Area Navigation (RNAV) Global Navigation Satellite System (GNSS) trials at the six UK airports in a CAA Paper**

CAA *Paper 2007/06 RNAV (GNSS) Non-Precision Approach – Flight Trials Analysis Report* was published on the CAA website in September 2007, and has received favourable feedback. As part of the preparation for the introduction of RNAV (GNSS) approaches for GA in the UK, the CAA also published *CAP 773 Flying RNAV (GNSS) Non-Precision Approaches in Private and General Aviation Aircraft*, which details how to fly these approaches.

2.5 **Prepare strategy for 'Approach with Vertical Guidance' (APV) implementation based on the results of the trial**

APV BaroVNAV approach procedures will only be authorised to suitable instrument runways at appropriately equipped and licensed aerodromes with ATC services. The design and roll-out of APV BaroVNAV approach procedures will be in response to individual requests for such designs from sponsors.

Since the Fishbone study group the CAA's Aerodrome Standards Department has learnt that DAP has been drafting this plan in response to a recent ICAO decision that all aerodromes are to have an APV approach by 2016. Baro VNAV is a term which is being replaced by APV 1 and APV 2. The introduction of the European Geostationary Navigation Overlay Service (EGNOSS), which will give greater accuracy both horizontally and vertically, will allow pseudo Instrument Landing System (ILS) approaches so Baro-aided approaches will be replaced.

2.6 **Complete the development of a GNSS approach validation tool and make it available for use**

Imperial College has delivered a software-based simulation capability to assess the effects of failures on the GPS navigation system's capability to support non-precision approach operations. CAA International is exploring commercial development opportunities for this software. DAP has also developed an Instrument Flight Procedure (IFP) validation tool for new GPS approaches.

2.7 **Seek changes to the specification of the displayed information to reduce the potential CFIT risk during RNAV (GNSS) operations**

See update below.

2.8 **Raise awareness of the meaning and correct use of the information displayed**

In approving the use of RNAV (GNSS) non-precision approaches, the CAA has recognised that a risk of CFIT may be created. It was noted during the flight trial that a number of GA pilots, using certain navigational equipment, reported a loss of situational awareness during the final approach that could have led to a premature final descent.

On specific equipment, step-down fixes (SDF) can appear as waypoints, thus segmenting the distance from the final approach fix to the threshold or missed approach point. A pilot, unfamiliar with the correct use of the information displayed, could mistake the distance displayed as the distance to the runway and commence a descent at the wrong time, and in an area that is not free from obstacles. For example, if an old DME counted down from ten miles out to zero at the Missed Approach Point, one could construct a mental picture of the descent profile based on a rough 300 ft per mile height loss. With SDFs inserted and pilots under pressure, the GPS distance read-out could be confused as a DME-style figure. So, at say five miles to go, if there is an SDF at two miles the GPS 'DME' will read three miles. If disorientated, the pilot might think he should be at 900 ft when the altimeter says 1500 ft. The ensuing dive could lead to CFIT.

The CAA has raised a Safety Plan item to mitigate the risk, by raising awareness of the meaning and correct use of the information displayed and by seeking changes to the specification of the displayed information to reduce the potential CFIT risk during RNAV (GNSS) operations. With these mitigations, this additional safety risk is not thought to outweigh the safety benefits of the introduction of such approaches.

Jeppesen have been persuaded not to show SDFs as waypoints and continuous descent approaches are now the norm.

2.9 **CAA to encourage operators to review training procedures on dealing with GPWS alerts**

A study of 'hard' GPWS warnings detected through UK operator Flight Data Monitoring (FDM) programmes and reported through the Mandatory Occurrence Reporting Scheme revealed that the assertion that "crews do not always react immediately to hard GPWS warnings" did not apply to UK operators.

As a result of this study, *AIC 111/2004 (Pink 75) – "Controlled Flight Into Terrain – Risk Avoidance"*, was revised and republished as *AIC 122/2006* incorporating suggestions made by the UK Flight Safety Committee. *FODCOM 6/99* was also revised and republished as *FODCOM 06/2007*, including up-to-date references and highlighting to operators the necessity of filing accurate occurrence reports of any GPWS hard warning events.

2.10 **Review CAP 516**

CAP 516 has been replaced by JAA *Temporary Guidance Leaflet 27 – "Training Programmes for the Use of Terrain Awareness and Warning Systems (TAWS)"*. The guidance in this leaflet was reviewed by the CAA and deemed to be adequate. The review did identify some improvements that could be made to the TGL, and these have been proposed to the JAA.

3 Analysis

3.1 Worldwide Fatal Accidents

Criteria: Worldwide fatal accidents involving jet or turboprop aeroplanes with original certified MTWA above 5,700 kg or 12,500 lb engaged on passenger or cargo flights and with at least one onboard fatality (excluding violent acts).

- For the ten-year period 1998 to 2007, there were a total of 245 worldwide fatal accidents meeting the defined criteria.
- Of the 245 worldwide fatal accidents, 57 (or 23%) involved CFIT.
- Of the 57 fatal CFIT accidents, 39 (or 68%) occurred during the approach or final approach phases of flight but only eight involved ILS approaches.
- Of the 39 fatal CFIT accidents that occurred during the approach or final approach phases of flight, 23 (or 59%) involved non-precision (15), visual/circling (6) or user-defined (2) approaches.
- Analysis of the 57 fatal CFIT accidents revealed the following top-five causal factors *(these are **not** mutually exclusive)*:
  - Lack of positional awareness in air: 54 (95%)
  - Omission of action / inappropriate action: 32 (56%)
  - Failure in CRM (cross-check/co-ordinate): 18 (32%)

- Slow and/or low on approach: 18 (32%)
- ‘Press-on-itis’: 14 (25%)

At least one of these top-five causal factors was allocated for each of the 57 fatal CFIT accidents. The 'omission of action / inappropriate action' causal factor related largely to continued descent below safety altitudes or decision heights without visual reference and/or failure to fly a missed approach.

- The last fatal CFIT accident involving a UK-registered or -operated aircraft meeting the defined criteria occurred on 25 April 1980 (B727 at Tenerife, 146 fatalities).
- As far as it is known, there has only been one fatal CFIT accident to an aircraft meeting the defined criteria that had a functioning TAWS onboard (BAe 146 at Wamena, Indonesia on 9 April 2009). However, it is believed that the flight crew inhibited the enhanced warning functions, leaving only GPWS functionality, and then deliberately ignored GPWS warnings. One other fatal CFIT accident to a TAWS-equipped aircraft occurred in Ecuador on 27 August 2008 but this involved a ferry flight. Again, it was suspected that warnings were ignored.

3.2 'Serious' CFIT-Related Mandatory Occurrence Reports (MORs) Involving UK Aircraft and/or UK Airspace

Criteria: CFIT-related reportable accidents, serious incidents and/or grade A or B MORs involving UK-registered or -operated jet or turboprop aeroplanes above 5,700 kg MTWA on passenger or cargo flights worldwide, or foreign registered or operated aircraft (as per UK criteria) in UK airspace only.

- For the ten-year period 2000 to 2009, there were a total of 24 occurrences, which included 19 serious incidents (as determined by the AAIB).
- 15 of the 24 occurrences involved UK-operated or -registered aircraft (seven in UK airspace and eight abroad) and the remaining nine involved foreign aircraft in UK airspace.
- All but three of the 24 occurrences involved passenger flights.
- Of the 24 occurrences, 17 (or 71%) occurred during the approach phase of flight.
- Of the 17 occurrences that occurred on the approach, 11 (or 65%) involved non-precision (7) or visual/circling (4) approaches.
- Most of the occurrences involved vertical flight path management errors such as significant deviations below the glideslope and/or cleared altitude, descent below decision/safety altitudes without the required visual reference and unstable approaches.
- Common factors included non-adherence to standard operating procedures (e.g. not flying a go-around from an unstable approach, absence of ‘decision calls’ and not setting QNH), inadequate monitoring and crew communication, distractions (e.g. due to aircraft technical issues) and lack of situational awareness.
- ATC intervention (e.g. issuing a go-around instruction, providing heading guidance and questioning aircraft’s altitude) was a positive factor in 13 cases. GPWS or EGPWS alerts/warnings helped to resolve ten occurrences.
- However, EGPWS warnings were insufficient for the two most severe occurrences, in which UK aircraft descended to within 56 ft and 121 ft of terrain at Addis Ababa and Khartoum respectively. The common link in these two cases was that GPS was not used as a source of position information for TAWS.

3.3 Other CFIT-Related MORs Involving UK Aircraft and/or UK Airspace

Criteria: CFIT-related grade C or D MORs involving UK-registered or -operated jet or turboprop aeroplanes above 5,700 kg MTWA on passenger or cargo flights worldwide, or foreign registered or operated aircraft (as per UK criteria) in UK airspace only.

- For the five-year period 2005 to 2009 inclusive, 180 "Pull Up" TAWS warnings were found on the MOR database.
- During the period April 2005 to March 2006, a subset of the above, there were 41 "Pull Up" TAWS warnings. A study of FDM data during the period April 2005 to March 2006 showed there were 54 "Pull Up" TAWS warnings (genuine or otherwise) on aircraft that represented 37% of the total number of flights flown for that period. Assuming uniform distribution across the remaining population, this equates to 145 warnings for all aircraft.
- A further search of the following CFIT related events was conducted for the period 2005-2009. These results are summarised below:
  - Descent below glidepath – 3
  - Incorrect descent below minimum descent altitude (MDA) / decision height (DH) – 4
  - Descent below minimum safe altitude (MSA) – 11
  - Altimeter setting errors during descent – 10
- In summary, comparing the results of FDM data with MOR data for "Pull Up" TAWS warnings and bearing in mind the extremely limited dataset for other CFIT related event types, the following conclusions can be drawn:
  - Precursors to CFIT are generally under-reported, in particular "Pull Up" TAWS warnings.
  - CFIT related events on the MOR database are coded in a variety of ways, not necessarily facilitating extraction of relevant information from the MORs database and supporting subsequent analyses.

3.4 Analysis Summary

- Fatal accident and 'Serious' MOR data has shown there to be an increased risk of CFIT during non-precision approaches.
- The most common causes of CFIT events were found to be: inappropriate descent below decision height / minimum descent altitude without appropriate visual references, inadequate CRM/monitoring and lack of positional awareness.
- Correctly following TAWS is an effective mitigation to CFIT, but relies on correct flight crew response, up-to-date terrain databases and software installation, and the most accurate source of position information.
- Regarding precursors to CFIT, due to the combination of under-reporting and variability in the classification of CFIT related events, it is difficult to determine the actual extent of CFIT risk to UK aircraft, using existing MOR data as a single source.
- In light of the weaknesses identified through using existing MOR data in isolation, the task force has recommended a number of SPIs which will use other sources of information that can be monitored by industry, to determine CFIT risk to UK aircraft.

- The task force has also recommended a dedicated study to obtain better CFIT precursor data, which would include an associated awareness campaign to improve reporting of appropriate events.

4 Safety Performance Indicators

The CFIT task force proposes two levels of SPIs. The first is high-level SPIs to monitor significant events associated with CFIT risk (e.g. GPWS/TAWS "Pull-up" warnings). These SPIs are expected to be produced by the CAA using MOR data. The second is lower-level SPIs, which can be viewed as precursors to the more significant events monitored by the high-level SPIs. It is expected that the lower-level SPIs will require data that might not be available to the CAA. However, it is recommended that the CAA encourages operators and service providers to monitor some of these lower level SPIs using their own data (e.g. air safety reports, FDM events, etc.) as part of the promotion of effective safety management systems. Information, rather than raw data, could then be shared with the CAA, either directly or in an aggregated form via an intermediate body such as the Flight Operations Liaison Group (FOLG).

A hierarchical structure of SPIs, such as that proposed by the CFIT task force, has been endorsed by ICAO and the EU.

4.1 High Level CFIT-Related SPIs

Number and rate (per million flights flown/approaches) of:

- (E)GPWS "Pull-Up" type warnings;
- MSAW warnings (once MSAW has become more established);
- descent below decision height/altitude or minimum descent/safety height/altitude without required visual reference.

4.2 Low Level CFIT-Related SPIs

Number and rate (per million flights flown/approaches) of:

- (E)GPWS warnings and alerts other than "Pull-Up" type warnings;
- false/nuisance (E)GPWS warnings due to navigation or terrain database errors;
- incorrect flight crew response to (E)GPWS warnings;
- unstable approaches continued to a landing (also as a proportion of all unstable approaches);
- significant deviations below glideslope (greater than x dots, below yyy ft AGL);
- significant deviations about the localiser (greater than x dots, below yyy ft AGL);
- altimeter setting errors.

4.3 Exposure Measures

The CFIT task force also recommends the collection of measures to help quantify exposure to CFIT risk. These measures do not need to be monitored as frequently as the SPIs (for example, annually rather than quarterly). Again, industry would be encouraged to provide much of this information. Such measures could include:

- proportion of UK public transport aircraft not equipped with GPWS or TAWS;
- proportion of UK public transport aircraft equipped with TAWS that does not have a direct GPS position feed;

- proportion of UK public transport aircraft equipped with TAWS that does not have the latest software installed;
- proportion of UK public transport flights that dispatch with unserviceable GPWS or TAWS;
- proportion of UK airports that receive public transport flights that do not have a precision navigation approach aid and/or GPS approach;
- proportion of foreign airports visited by UK public transport aircraft that do not have a precision navigation approach aid and/or GPS approach;
- proportion of approaches flown by UK public transport aircraft in IMC:
  - for all approaches;
  - for non-precision approaches.
- proportion of approaches flown by UK public transport aircraft at night:
  - for all approaches;
  - for non-precision approaches.
- proportion of departures/approaches flown by UK public transport aircraft with 'significant terrain' in vicinity of airport.

Appendix 1 Recommendations

Task Force:

Controlled Flight into Terrain

Recommendation Reference:

CFITTF01

Recommendation Title:

It is recommended that the CAA carries out a cost/benefit analysis of deploying Minimum Safe Altitude Warning (MSAW) systems at appropriate UK aerodromes.

Recommendation Scope: *(tick all that apply)*

Regulatory Change ☐ Guidance Material ☐ Training ☐ Further Study/Research ☒

Procedural Change ☐ Technology ☒ Other

Addressee (e.g. CAA):	If CAA, then Proposed Recommendation Sponsor (CAA Business Area):
CAA	Air Traffic Standards

Justification:

Risk(s) to be Mitigated (focus on safety risk, business risk optional):

Aircraft descending below a safe profile without ATC being aware.

Risk(s) of not Implementing:

The rate of CFIT accidents/incidents, particularly on non-precision approaches or due to controller error will continue.

Benefits:

Reduction in CFIT accidents/incidents.

Supporting Data:

Eurocontrol have demonstrated that the implementation of MSAW can be effective in the prevention of CFIT accidents [Eurocontrol, (June 2009) Netalert]. Three specific CFIT incidents are cited where aircraft descended to an unsafe and unplanned distance from terrain: Orly 1997, Dublin 2007 and Yerevan 2008. In each case the installation of MSAW would have provided timely alerts.

Task Force:

Controlled Flight into Terrain

Recommendation Reference:

CFITTF02

Recommendation Title:

It is recommended that the CAA engages with EASA to carry out a cost/benefit analysis and feasibility study for requiring TAWS databases to be certified (including a requirement for regular updates) and for requiring a direct feed of GNSS-based aircraft position data into TAWS.

Recommendation Scope: *(tick all that apply)*

Regulatory Change ☒ Guidance Material ☐ Training ☐ Further Study/Research ☒

Procedural Change ☐ Technology ☒ Other

Addressee (e.g. CAA):	If CAA, then Proposed Recommendation Sponsor (CAA Business Area):
CAA	Airworthiness

Justification:

Risk(s) to be Mitigated (focus on safety risk, business risk optional):

The incidence of false or nuisance TAWS warnings and the absence of a warning when genuinely warranted. CAA not encouraging best practice.

Risk(s) of not Implementing:

The rate of CFIT accidents/incidents will not achieve a continuous improvement. Lack of flight crew trust in the credibility of TAWS, leading to increased risk of inappropriate flight crew response to genuine TAWS warnings.

Benefits:

Reduction in CFIT accidents/incidents and incidence of false or nuisance TAWS warnings.

Supporting Data:

The proposal is to provide a cost/benefit analysis for requiring all new TAWS installations and TAWS specifications for future aircraft to have a direct feed of GNSS-based aircraft position. Honeywell research indicates that this significantly improves the ability for TAWS to provide an accurate and timely warning. The regular updating of TAWS databases is not mandated, and many aircraft may be fitted with early versions of TAWS software, which provide reduced capability.

A study conducted by Honeywell found that 62.3% of "Look Ahead" TAWS warnings were nuisance or false as a result of database errors. Of these database errors, 47% were due to runways missing from the database and a further 42% were due to terrain errors in the database.

Two of the most severe non-fatal CFIT-related occurrences to UK public transport aeroplanes (A320 at Addis Ababa in 2003 and A321 at Khartoum in 2005) involved non-optimal TAWS warnings. In both cases GPS was not used as a source of position information for TAWS.

Task Force:

Controlled Flight into Terrain

Recommendation Reference:

CFITTF03

Recommendation Title:

It is recommended that the CAA engages with EASA to review the philosophy in allowing operators to dispatch with inoperative TAWS equipment for up to 10 days.

Recommendation Scope: *(tick all that apply)*

Regulatory Change ☒ Guidance Material ☐ Training ☐ Further Study/Research ☒

Procedural Change ☐ Technology ☐ Other

Addressee (e.g. CAA):	If CAA, then Proposed Recommendation Sponsor (CAA Business Area):
CAA	Airworthiness

Justification:

Risk(s) to be Mitigated (focus on safety risk, business risk optional):

Risk associated with the non-availability of a timely TAWS warning. Safety case allowing current MEL alleviation may be inappropriate. EASA and CAA have an obligation to achieve a continuous improvement in safety.

Risk(s) of not Implementing:

Increased exposure of aircraft to the risk of a CFIT accident/incident.

Benefits:

Reduction in CFIT accidents/incidents.

Supporting Data:

A safety case to include analysis of genuine TAWS warnings to date should be carried out to determine whether the current MEL alleviation is appropriate. Many operators have TAWS warnings included in their FDM programmes, hence a significant amount of accurate data is now available.

Task Force:

Controlled Flight into Terrain

Recommendation Reference:

CFITTF04

Recommendation Title:

It is recommended that the CAA carries out a study to obtain better safety data regarding the precursors to CFIT accidents, including a truer picture of the number and rate of TAWS warnings of all types: genuine, nuisance and false.

Recommendation Scope: *(tick all that apply)*

Regulatory Change ☐ Guidance Material ☐ Training ☐ Further Study/Research ☒

Procedural Change ☐ Technology ☐ Other

Addressee (e.g. CAA):	If CAA, then Proposed Recommendation Sponsor (CAA Business Area):
CAA	Group Safety Services

Justification:

Risk(s) to be Mitigated (focus on safety risk, business risk optional):

There is a lack of accurate and complete precursor information relating to CFIT accidents. This hinders the development of strategies to mitigate this risk area.

Risk(s) of not Implementing:

Over reliance on TAWS rather than the elimination of the precursors of CFIT.

Benefits:

Improved knowledge of CFIT precursors, hence reduced risk of CFIT accidents to UK aircraft. Improved crew awareness of operational issues.

Supporting Data:

A study of FDM data during the period Apr 05 - Mar 06 showed there were 54 “Pull up” TAWS warnings (genuine or otherwise) on aircraft that represented 37% of the population for that year, in terms of flights flown. Assuming uniform distribution across the remaining population, this equates to 145 warnings for all aircraft.

In comparison, there were 41 (genuine or otherwise) “Pull up” TAWS warnings during the same period reported to the CAA as MORs. This suggests significant under-reporting of “Pull Up” TAWS warnings.

Task Force:

Controlled Flight into Terrain

Recommendation Reference:

CFITTF05

Recommendation Title:

It is recommended that the CAA encourages UK operators to consider including circling approach training in their recurrent checks. It is also recommended that operators should be encouraged to provide detailed procedures for aerodromes that have significant obstacles in the circling area or special requirements when circling.

Recommendation Scope: *(tick all that apply)*

Regulatory Change ☐ Guidance Material ☒ Training ☒ Further Study/Research ☐

Procedural Change ☐ Technology ☐ Other

Addressee (e.g. CAA):	If CAA, then Proposed Recommendation Sponsor (CAA Business Area):
CAA	Licensing & Training Standards

Justification:

Risk(s) to be Mitigated (focus on safety risk, business risk optional):

CFIT accidents/incidents during circling approaches due to insufficient terrain and obstacle data in TAWS databases, and/or lack of detailed procedures.

Risk(s) of not Implementing:

Reliance on TAWS rather than strategies to reduce CFIT risk. CFIT accidents/incidents occurring due to lack of knowledge, procedures and/or practice in circling approaches.

Benefits:

If a straight-in approach option is not feasible, then the risk of flying circling approaches will be mitigated for flight crew with improved training and situational awareness, and by equipping them with procedures to improve safety margins.

Supporting Data:

IATA and ICAO:

- In their joint study into CFIT, IATA and ICAO estimated that runway-aligned or straight-in approaches are about 25 times safer than the circle-to-land procedure.

Task Force:

Controlled Flight into Terrain

Recommendation Reference:

CFITTF06

Recommendation Title:

It is recommended that the CAA, in conjunction with NATS, carries out further analysis of downloaded Mode S data to determine the incidence of altimeter sub-scale mis-setting.

Recommendation Scope: *(tick all that apply)*

Regulatory Change ☐ Guidance Material ☐ Training ☐ Further Study/Research ☒

Procedural Change ☐ Technology ☐ Other

Addressee (e.g. CAA):	If CAA, then Proposed Recommendation Sponsor (CAA Business Area):
CAA	Air Traffic Standards

Justification:

Risk(s) to be Mitigated (focus on safety risk, business risk optional):

CFIT accidents/incidents due to mis-set altimeters, particularly on non-precision approaches. This could render TAWS ineffective.

Risk(s) of not Implementing:

Uncertainty of the associated risk.

Benefits:

If the risk is found to be significant, strategies for reduction could be developed, such as:

- Mandating TAWS with geometric altitude input – already available.
- Developing a ground-based warning system using downloaded Mode S altimeter sub-scale data.

Supporting Data:

NATS have demonstrated the validity and availability of Mode S BPS data [NATS, (2010) *Summarised report into the viability of using the Mode-S Barometric Pressure Setting*], with 80% availability achieved for aircraft above the transition altitude. Although the study was primarily in support of reducing level busts, altimeter setting error leads to potential CFIT risk for aircraft. The paper noted that “a clear majority of flight crews change altimeter settings in a timely manner… However, despite commendable airmanship from the majority of crews, there are a few examples of errant behaviour that warrant further action.”

Task Force:

Controlled Flight into Terrain

Recommendation Reference:

CFITTF07

Recommendation Title:

It is recommended that the CAA engages with EASA/EUROCONTROL/ICAO to increase the rate at which traditional NPAs are replaced by GNSS equivalents.

Recommendation Scope: *(tick all that apply)*

Regulatory Change ☐ Guidance Material ☐ Training ☐ Further Study/Research ☐

Procedural Change ☒ Technology ☒ Other

Addressee (e.g. CAA):	If CAA, then Proposed Recommendation Sponsor (CAA Business Area):
CAA	Air Traffic Standards

Justification:

Risk(s) to be Mitigated (focus on safety risk, business risk optional):

The high proportion of CFIT accidents/incidents that occur during traditional NPAs.

Risk(s) of not Implementing:

Continuing high proportion of CFIT accidents/incidents during NPAs. Non-implementation of currently available technology.

Benefits:

Reduction in CFIT accidents/incidents. More efficient use of runway capacity.

Supporting Data:

IATA and ICAO:

- In their joint study into CFIT, IATA and ICAO estimated that runway-aligned or straight-in approaches are about 25 times safer than the circle-to-land procedure. The availability of RNAV (GNSS) approaches will reduce significantly the need for flying circle-to-land procedures.

Flight Safety Foundation and NLR:

- Of 118 fatal approach and landing accidents, involving jet and turboprop aeroplanes (with maximum take-off weight above 12,500 lbs or 5,700 kg) and occurring between 1980 and 1996, for which the type of approach flown was known: 75% occurred where a precision approach aid was not available or was not used.
- A joint study by the NLR and FSF concluded that, on a worldwide basis, there appears to be a five-fold increase in accident risk for commercial aircraft flying traditional non-precision approaches compared to those flying precision approaches.

Task Force:

Controlled Flight into Terrain

Recommendation Reference:

CFITTF08 [Generic across multiple Task Forces]

Recommendation Title:

It is recommended that the CAA, through the Safety Risk Management Process Project, conducts a review of safety data collection, coding and analysis to best establish and monitor the key risks to UK civil aviation and to track the success of associated recommendations. This review should, among other things:

- establish an appropriate risk classification scheme for MORs;
- establish a multi-tiered structure of SPIs to monitor the key safety risks (high-risk SPIs at the top and drilling down into lower-level precursors);
- identify alternative sources of safety data outside the scope of the MOR Scheme (e.g. FDM) to fill gaps in our safety knowledge;
- propose mechanisms for such data to be shared, with appropriate safeguards;
- propose a standardised set of measures, based on such data, for industry to monitor and report to the CAA (these measures would contribute the lowest level pre-cursors to the key safety risks).

Recommendation Scope: *(tick all that apply)*

Regulatory Change ☐ Guidance Material ☒ Training ☐ Further Study/Research ☒

Procedural Change ☒ Technology ☐ Other

Addressee (e.g. CAA):	If CAA, then Proposed Recommendation Sponsor (CAA Business Area):
CAA	Group Safety Services

Justification:

Risk(s) to be Mitigated (focus on safety risk, business risk optional):

Risk of not making best use of safety data.

Risk(s) of not Implementing:

Not identifying a safety issue or not affording it the priority it warrants. Potential disconnect between the CAA and industry on what each perceives to be the most significant safety risks.

Benefits:

Confidence that safety risks have been identified and appropriately prioritised, and that industry understands and buys-in to the resulting risk mitigation strategies.

Supporting Data:

FDM data has been identified as a useful source of data regarding precursors to CFIT-related accidents/incidents.

Task Force:

Controlled Flight into Terrain

Recommendation Reference:

CFITTF09

Recommendation Title:

It is recommended that the CAA reviews the implementation of TAWS for UK public transport helicopter operations.

Recommendation Scope: *(tick all that apply)*

Regulatory Change ☐ Guidance Material ☒ Training ☒ Further Study/Research ☒

Procedural Change ☐ Technology ☐ Other

Addressee (e.g. CAA):	If CAA, then Proposed Recommendation Sponsor (CAA Business Area):
CAA	Flight Operations

Justification:

Risk(s) to be Mitigated (focus on safety risk, business risk optional):

TAWS is fitted to some modern helicopters, but current guidance and training in its use is not optimal.

Risk(s) of not Implementing:

A proven safety net will either not be available to helicopter pilots or its potential will not be fully realised.

Benefits:

Improved crew awareness. Reduction in CFIT accidents/incidents.

Supporting Data:

There is little hard supporting MOR data probably due to under-reporting, but there is some anecdotal evidence from operators.

Appendix 2 Terms of Reference

Introduction

The purpose, composition, functions and procedures of the task force are described below. The task force has responsibility for the revision and administration of these Terms, for Safety Risks Team (SRT) approval.

Purpose

To work with CAA and industry specialists to establish the principal causes of CFIT accidents and incidents to commercial air transport aircraft and to recommend strategies for monitoring and reducing the associated risk.

Definition

A CFIT accident is defined as an event where a "mechanically normally functioning" aircraft is inadvertently flown into the ground, water or an obstacle. An incident is where the aircraft is inadvertently flown closer to the above than the crew intended. The activation of an EGPWS warning is included.

Key Tasks

- Perform a literature review of work already completed or underway in this area, both at the CAA and externally.
- Undertake a systematic analysis of the hazards relating to CFIT, the precursors, and the risks.
- Create strategies for reducing the risks.
- Develop a safety performance indicator to monitor the risks and propose a target acceptable level.

Membership

Membership comprises of a chairman and secretary (together forming the secretariat), CAA experts and industry representatives.

The secretariat are from Flight Operations Inspectorate.

Capt. David Russell	Chairman	Regional Manager (Operations)
Capt. Frank Zubiel	Secretary	FOI Aeroplanes

The following CAA experts will be members:

Capt. Mike McDougal	FOI Helicopters
Mark Bonnick	Engineering
Joji Waites	Project Manager
Matthew Lillywhite	Safety Analyst
Graeme Ritchie	Aerodrome Standards Officer
Ian MacLaren	Design Surveyor
Pat Lowrence	Inspector Air Traffic Services

Industry representatives from the following organisations will be represented:

Capt. Paul Smiles	BA Flight Operations
Capt. James Basnett	BA Flight Operations
Capt. Jim Pegram	easyJet Flight Operations/Safety Department
Malcolm Rusby	European Safety Director, TAG Aviation
F.O. Robert Innes	Flight Safety Officer, TAG Aviation
Capt. Simon Cotterell,	Flight Crew Manager, CHC Scotia
Mrs Karen Bolton	NATS
Bruce Crawford	GAPAN
Alan Howell	Honeywell

Methodology

The secretariat will review previous work carried out by the CAA and circulate this and these terms of reference to the members. The membership will be requested to comment and provide details of any relevant risk analysis and reduction strategies in their organisation, or which they have access to.

Meetings will be held as required to present analysis of the data and any proposals for risk reduction strategies and safety performance indicators.

Deliverables

i) Recommendations for safety improvements presented in an EC Paper, endorsed by the SRT and Directorate of Airspace Policy management.

ii) Presentations of the work of the task force, its conclusions and recommendations at the CAA Safety Conference.

iii) Presentation of an interim report at the CAA RETRE Conference (November 2009).

iv) Presentation of an interim report to SRT.

v) Presentation of a final report to SRT including recommendations and CFIT performance indicators.

Records

Meeting agenda and notes will be recorded on ERMS.

Report 4 Runway Incursion and Ground Collision Task Force

Executive Summary

Work to study and address the risks associated with ground collision and runway incursion was overseen by the UK CAA Runway Incursions Steering Group (RISG). RISG continues to oversee initiatives to reduce the risk to the safety of Civil Aviation operations arising from Runway Incursion (RI) incidents. This report covers its actions, and the RI statistics gathered up to 31 December 2009.

Since 2007, RISG has been using the ICAO definition of RIs, i.e. "*Any occurrence at an aerodrome involving the incorrect presence of an aircraft, vehicle or person on the protected area of a surface designated for the landing and take-off of aircraft.*"

Analysis of RI data for 2009 shows that the number of incidents reported has decreased. The 2009 figure of 173 reported RIs compares with 198 for 2008, a reduction of 12.6%. However, this could partly be due to the (approximately 10%) reduction in traffic caused by the current economic downturn.

In the last 12 months, there have been no risk category A RIs. In the same period, 1% were in risk category B, 13% were in risk category C and 83% were in risk category D.

However, a recent RI at Newcastle (23 April 2010), involving a light aircraft may be classified as a category A incident.

In the last 12 months, 60% of RIs involved aircraft, 36% involved vehicles and 4% involved people.

RISG membership includes representatives from across the CAA SRG, Aerodrome operators, AOC holders, the MOD, NATS and UKFSC.

A subgroup of RISG looked at ground collisions involving large commercial air transport aircraft (<5700 kg) moving between the ramp and the Runway Protected Area.

In the last three years, there have been seven such incidents, and just one injury (a cabin crew member with a broken arm).

At the end of 2009, chairmanship of RISG was changed from CAA SRG Air Traffic Standards to Flight Operations.

RISG meets quarterly, with its subgroups meeting on a more regular basis.

1 RISG Subgroups

1.1 Runway Incursions Technologies Subgroup (RITSG)

1.1.1 Review Status of RITSG

RITSG met on 30 November 2009. As the subgroup had not met for a while and had a new chairman it reviewed the Terms of Reference (TOR). The TOR was amended to include an additional objective, namely to support industry initiatives to reduce the risk of RIs.

1.1.2 NATS Protocol

1.1.2.1 Two Runway Incursion Alerting workshops, hosted by NATS, were held on 30 September 2009 and 22 January 2010. The first workshop gave a chance for various organisations to give an update of their current technological solutions to prevent RIs. A draft protocol was introduced and developed at the second meeting.

1.1.2.2 NATS has identified that there is a proliferation of different technologies and a wide spectrum of development, manufacturing and design capability from various manufacturers. The idea behind the workshops was to start the process to identify a possible protocol, design specification or standard for RI alerting systems that will hopefully have benefits for the industry.

1.1.2.3 NATS feels that providing a framework will allow airport operators and ANSPs to make informed decisions about the level of alerting they require to mitigate their risk. It will allow equipment manufacturers to design systems with performance characteristics understood by all and it will allow flight crews to train for a consistent type of warning across different systems, with clearly understood actions following an alert.

A draft protocol was presented to the RISG meeting on 18 February 2010 and further work is ongoing.

1.1.3 **Developments of Runway Status Lights (RWSL) System.**

1.1.3.1 The subgroup reviewed developments regarding the RWSL system. The system is fully automatic and is designed to reduce the number and severity of RIs. Surface and terminal surveillance systems, such as ASDE-X and AMASS, detect the presence and motion of aircraft and vehicles on or near a runway. The Runway Status Light safety logic then assesses any possible conflicts with other surface traffic. Red Entrance Lights (REL) embedded in the pavement, in line with the taxiway centreline marking leading onto the runway are illuminated if the runway is unsafe for entry or crossing. Red Takeoff Hold Lights (THL) embedded in the pavement in-line with the runway centreline marking for approximately the first 300 m of the runway, are illuminated if the runway is unsafe for departure. Further details of the system can be found at http://www.rwsl.net**.**

1.1.3.2 The system has been trialled at Dallas and San Diego airports and the FAA has announced that the system will be installed at 22 major airports across the USA. The FAA is also promoting the system at the ICAO level. There are also plans to install and trial the system at Charles de Gaulle airport in Paris. The subgroup is aware that initial discussions have taken place between NATS and BAA regarding the potential to install the system at Heathrow.

1.1.3.3 A EUROCONTROL workshop was held in Paris on 29 April 2009. The objective of the workshop was to open the discussion on the use or runway status lights in conjunction with stop bars and to identify the hazards of using the two systems together. EUROCONTROL are working on a safety case regarding using both systems together.

1.1.3.4 Currently there is no guidance in ICAO *Annex 14* or CAA *CAP 168* regarding a standard for RI technology.

IFALPA has indicated that a red light should signal a pilot to stop. Currently there may be a requirement to pass the red/white and then red centreline lights that mark the final portion of the runway. It should be noted that future developments of LED technology would allow the red lights to be replaced by amber/yellow lights that clearly differentiated from white LED lights.

At Milan (Linate), a system uses sensors to detect an aircraft that crosses an illuminated red stop bar and warns pilots by illuminating in-pavement and side red strobe lights. This system (RIPCAS) has been certified by ENAC.

1.1.4 **Other Technologies**

1.1.4.1 Trials are underway at Manchester and Birmingham of a GPS-based system that alerts vehicle drivers if they are approaching a runway (potential for a RI).

1.1.4.2 The Ground Marker system trial is still ongoing. Ground Marker is manufactured by Axis Electronics and uses the 75 MHz marker system on aircraft to give an aural message/warning to pilots at predetermined positions on the aerodrome using sensors embedded in the ground. Although the Manchester trial has stopped, the manufacturer has identified Luton and Belfast as other potential trial aerodromes. One potential problem with the system is that crews do not regularly use the marker system on the aircraft and robust Standard Operating Procedures (SOPs) would need to be introduced to ensure that the system is effective.

1.1.4.3 Trials of high-intensity LED lights are planned for Manchester. Phase 1 will commence at Manchester Airport in February 2010 with one-third of the 23L/05R centreline lights replaced with ADB LEDs. These will be installed towards the east of the mid-point so that aircraft landing from the west have standard tungsten halogen lamps for the approach and touchdown.

ATG (a lighting manufacturer) plan to engage with a smaller aerodrome to install their elevated bi-directional edge lights to widen the scope of the trial. Safegate have yet to offer an industrialised product but will participate as an observer. The first phases of the trial are expected to last three months. LED technology would allow the red centreline lights to be replaced by amber/yellow lights that clearly differentiated from white LED lights.

1.1.5 Sharing Safety Information

In 2006 the RITSG commissioned Helios to produce a report that would gather as much available information as possible on RI prevention technologies, survey their capabilities and then rate them in order of merit against agreed criteria. The report was finalised in 2007.

The report only considered technologies that were deployable within approximately five years, able to provide guidance and/or warnings to Air Traffic Controllers, pilots or drivers, suitable for UK operations, and considered able to contribute to a reduction in the number of RIs.

Since then the report has remained within the CAA, but recently a number of requests have been received for a copy of it. The matter was raised at the RISG meeting on 18 February 2010 and the view of the group was that the report should be shared where appropriate.

However, mindful of the sensitivities of the report's contents, further advice will be sought from the CAA's Safety Risks Team (SRT) and CAA senior management before any decision is made.

1.2 Runway Incursions Publicity Subgroup

There is nothing significant to report from the Publicity subgroup except that the previous Runway Incursion Safety Awareness Campaign had been well received. The group has secured £6,000 for a further production run of RI awareness coasters.

1.3 Runway Incursions Data Analysis Subgroup

An analysis of data is contained in Appendices 1 and 2.

1.4 Aerodrome Operations Team

The CAA's Aerodrome Standards Department (ASD) continues to be focused on the RI risk, at all UK-licensed aerodromes. RIs are tackled as a high priority at each audit and on receipt of Mandatory Occurrence Reports (MORs). The MORs are pursued with the aerodromes which investigate, involving their Local Runway Safety Team (LRST) as necessary.

ASD has embedded processes to categorise and analyse MORs reported at UK licensed aerodromes. ASD has further developed its RI summary reports into a dashboard, which enables early identification of events, the highlighting of trends and identification of significant changes to risk posed by RIs, both nationally and at individual licensed aerodromes.

ASD has continued to work closely with the Airport Operators Association (AOA) on RI issues nationally and through its membership of the ICAO Aerodromes Panel, to promote RI prevention.

1.4.1 Publications

ASD has published an amendment to *CAP 168* (July 2010), which includes improved incursion prevention systems and procedures arising from trials conducted over the past two years, and which emphasise the dynamic role of LRSTs, which have become firmly established across UK aerodromes.

Arising from a need for national guidance on airside vehicle operations and driver permits, ASD has developed a new CAP (*CAP 790*) addressing airside vehicle operation and driving. The CAP will recommend driver requirements and training standards to be set by aerodrome authorities, and includes material on driver training, qualifications (including medical and language requirements) and maintenance of competency, and on vehicle standards. This CAP covers driving to prevent RIs and addresses driving operations on the apron, which was one of those activities identified by the Ground Handling Fishbone Study Group as a root cause of incidents and accidents on the apron.

Resulting from a working group involving industry, the CAP details a generic airside driver training programme which covers safety aspects of operating vehicles, plant and equipment in close proximity to aircraft on aprons, stands and airside roads. Where the specific job function requires the driver to operate on the manoeuvring area then additional training on the hazards associated with runways and taxiways is detailed, including use of VHF radio communications with Air Traffic Control, which will require training in the correct use of RTF and standard phraseology.

Formal consultation with industry took place during the first half of 2010, with the CAP due to be published early in 2011; it will become the core airside vehicle and driver permit document.

1.4.2 Activities

As highlighted in the 2009 progress report, ASD initiated a review of Runway Ahead markings and subsequently initiated a trial into the markings at Prestwick Airport, which concluded in 2009. The results were positive and the markings have received strong support, notably from flight crew organisations.

ASD has overseen two trials into visual aids at Manchester Airport. One involved the use of enhanced stop bars, where the light fittings making up a stop bar are spaced equally across the taxiway at reduced intervals, and the other, which started in 2008, involved a study into the continuous operation (H24) of runway stop bars.

Following the success of these trials it is planned to include their results, along with other RI prevention mitigation measures involving improvements to runway guard lights, into *CAP 168*. Consultation on an amendment has been completed and these measures have received strong support.

1.4.3 ICAO

The UK is a member of the Aerodromes Panel Visual Aids Working Group and has promoted several new technology developments for inclusion into ICAO Annex 14.

The main work item for this group is to develop requirements for visual aids for advanced surface movement guidance and control systems (A-SMGCS) and for prevention of RIs. The UK has supported work developed elsewhere and authored new draft requirements for additional simple touchdown zone lights, the use of LED technology in visual aids, and means to enhance the conspicuity of stop bars through reduced spacing between units.

1.4.4 EUROCONTROL Runway Incursion Prevention Working Group

The UK RISG is represented on the EUROCONTROL Runway Incursion Prevention Working Group and both groups support the other's work. During the past year the group has met four times, with work concentrated on developing the revised *European Action Plan for the Prevention of Runway Incursions* (EAPPRI). This document, which was first published in 2003, contains recommendations and guidance for all organisations involved with the prevention of RIs. The UK has been actively involved in pursuing improvements and additions to the EAPPRI recommendations, is drafting guidance material on regulatory oversight, and has developed a new appendix on aerodrome design to prevent incursions. This work continues and a revised EAPPRI was due to be published in Autumn 2010.

It is reported that NATS will be asking the ATC Procedures Working Group to redraft the Supplementary Instruction and the proposed MATS Part 1 material on unserviceable stop bars as there appears to be some confusion in the interpretation of the wording in *CAP 493*.

It was also reported that there is a major new initiative on RIs at Heathrow and that there is now an airport website from which operators could obtain information.

1.5 Operations Subgroup

It is planned that RISG will work with the Flight Operations Inspectorate on Standard Operating Procedures (SOPs).

Planned attendance at the FAA Runway Incursion Conference in Washington during December 2009 was cancelled due to the current financial issues.

The group is currently engaging with industry in order to understand operators' concerns with regard to RI events. In addition, it is looking at the following areas:

- Establish where RI events sit on operator risk registers.
- Understand how operators manage the RI safety risk.
- Share best practice where appropriate.
- Confirm what industry expects of RISG and what opportunities for enhancement exist

To date, the Operations subgroup has met with British Airways, Virgin, easyJet, Flybe and Air Southwest. Initial feedback from operators shows that most are very much in favour of 'Runway Hot-Spots' being identified on aerodrome charts. This subject has been circulated to all RISG members for discussion, and will be raised again at the next quarterly meeting.

1.6 Ground Collisions Subgroup

The current UK data suggests that there is minimal risk associated with this area. There are no trends, and there is insufficient data to provide a meaningful SPI.

The SRT may wish to consider whether this subgroup should become dormant with RISG keeping a watching brief on this area.

1.7 **The Future**

RISG will continue to meet quarterly, and will support the subgroups that will meet on a more regular basis.

In addition, it is planned to engage more with industry so that common goals and deliverables can be achieved. It is hoped that this will contribute to a continued reduction in RIs.

RISG will work with Flight Operations to ensure that robust SOPs are in place for avoiding RIs.

It is important that causal factors are investigated, as effective identification of these can lead to targeted RI avoidance training. In addition, technological advances will be explored in cooperation with other agencies.

1.8 **Conclusion**

1.8.1 RISG is a well-established group that continues to provide tangible safety benefits. Its work with external agencies, industry and within the CAA provides for an excellent integrated approach to the current issues.

1.8.2 RISG will continue to engage with all interested parties (internal and external) in order that it can better identify causal factors and RI preventative measures. It is envisaged that these will include both technical and non-technical measures. The aim is to work towards a reduction in RIs that involves all stakeholders.

1.9 **Recommendations**

1.9.1 The intention is to produce the next annual report in April 2011.

1.9.2 RISG has produced seven recommendations, and these are attached at Appendix 3.

NOTE: All of the RISG recommendations will help to drive the current SPI targets of a reduction in RI events, and ground collisions. Therefore, no new SPIs have been developed, as they were deemed to be not required.

Appendix 1 Data Analysis – Summary of RI Data

Overview

During the last five years there have been 895 reported RIs. As of the 16 February 2010 there have been 178 reported RIs in 2009. Figure 1 shows the number of RIs annually since 2005.

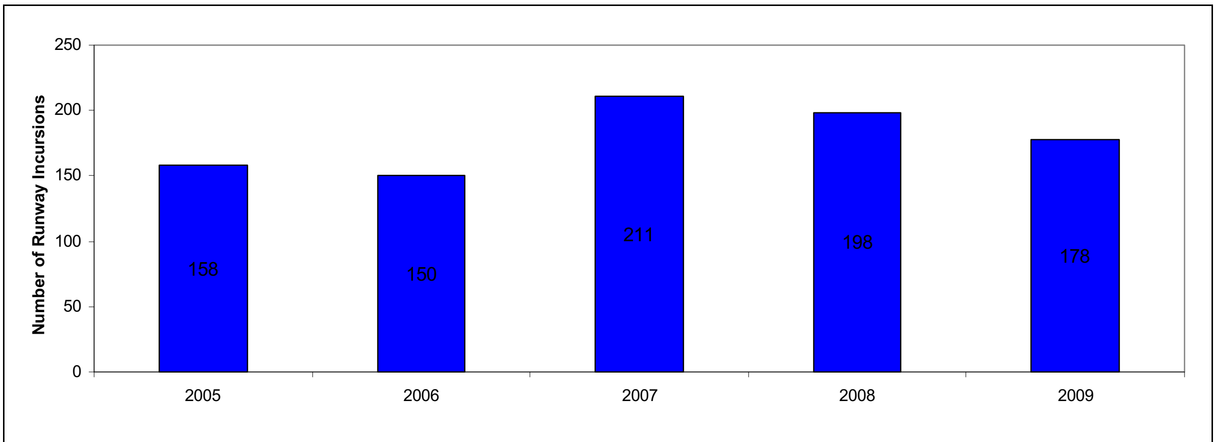


Figure 1 RIs during the last Five Years

In order to show any seasonal variations, the data can be broken down by month and compared with previous years. Figure 2 shows the monthly number of RIs from January 2007 onwards.

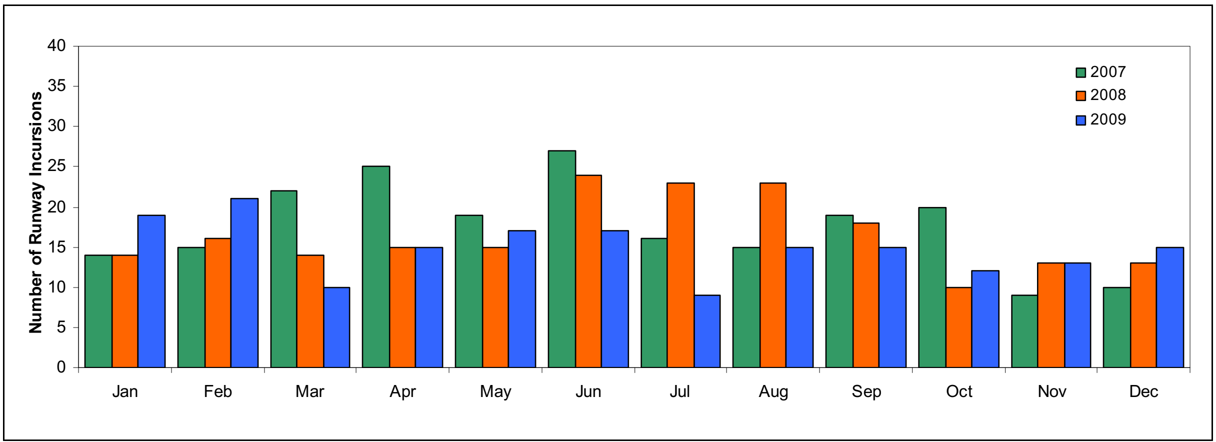


Figure 2 Monthly Breakdown of RIs since January 2007

The data can also be shown as a 12-month moving average, as shown in Figure 3. Each column is split into the risk categories assigned using the FAA 'Runway Safety Occurrence Severity Matrix'. Incursions that have not yet been reviewed by the data subgroup are labelled 'X'.

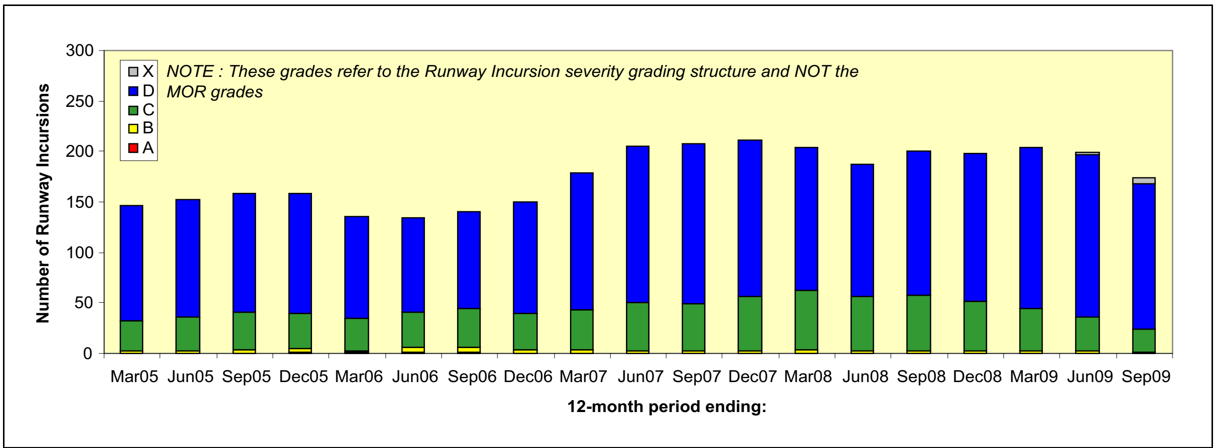


Figure 3 Rolling 12-month average of RIs since the year ending March 2005

Since the number of high-risk RIs is difficult to see in Figure 3, these are provided separately in Figure 4.

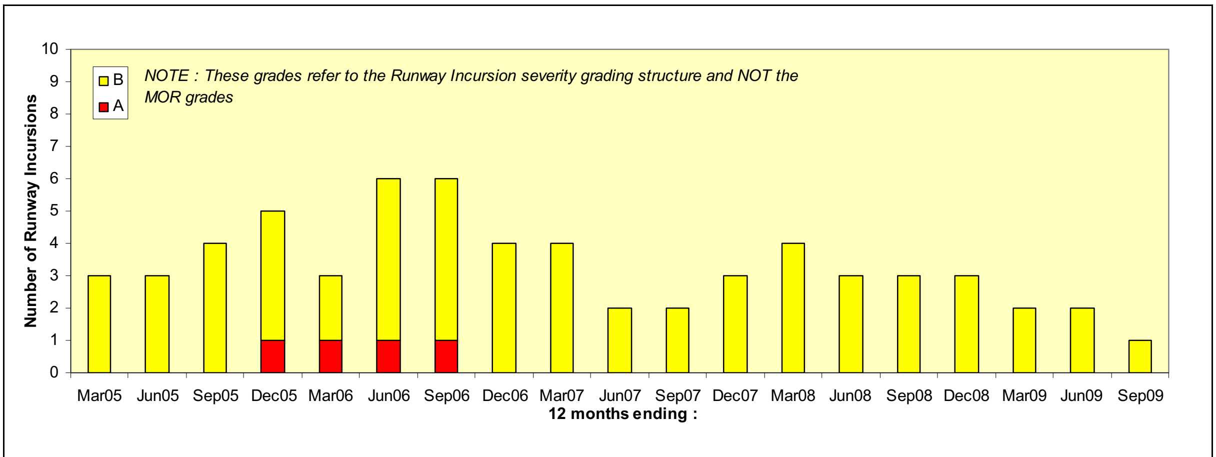


Figure 4 Rolling 12-month average of High-risk RIs since the year ending March 2005

Changes over time

The charts in this section compare the 178 RIs from 2009 with the 198 RIs from 2008.

During 2009, none of the RIs were in risk category A or B, 12% were in risk category C and 74% were in risk category D. 15% have yet to have a risk category assigned.

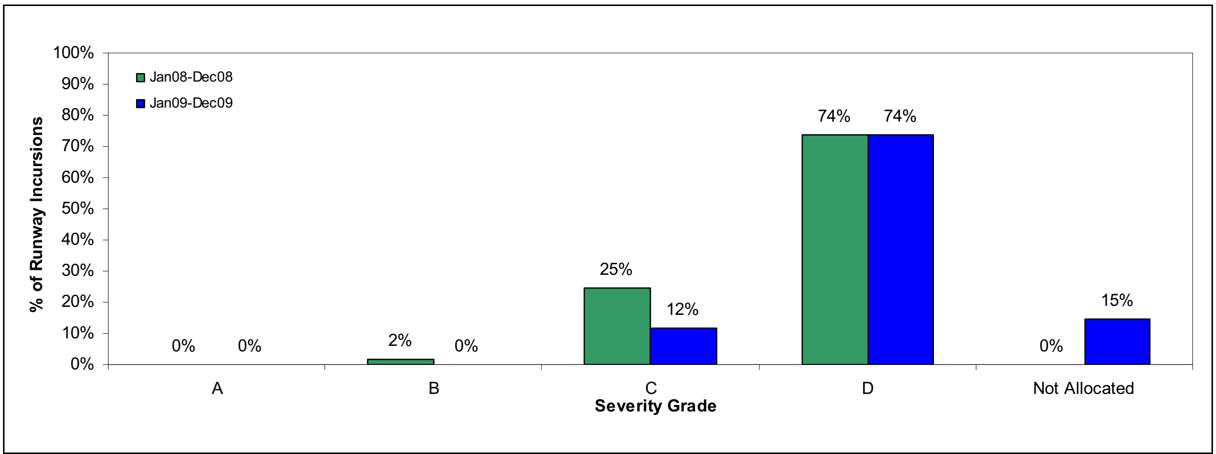


Figure 5 Risk Categories (comparing Jan 08–Dec 08 with Jan 09–Dec 09)

Figure 6 shows the number of RIs broken down by size of airport.

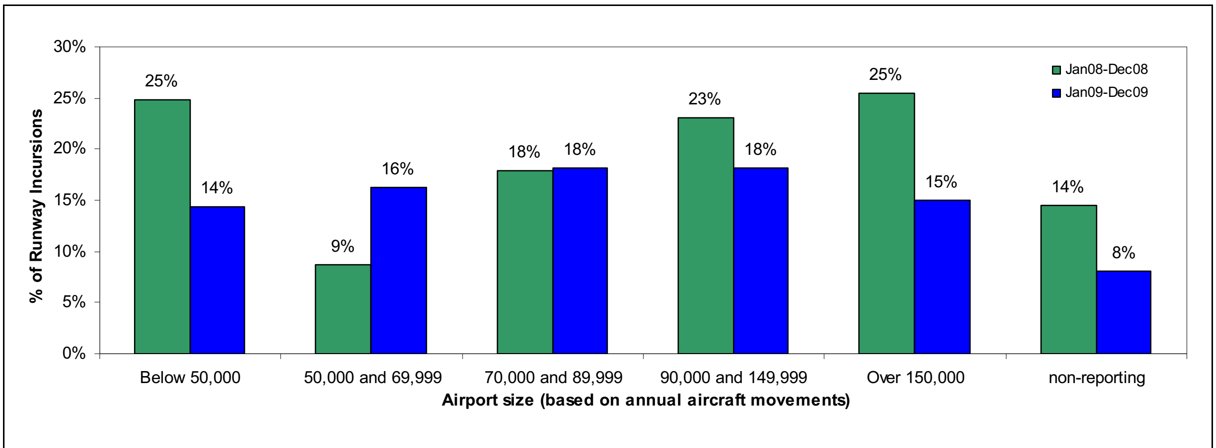


Figure 6 RIs broken down by Airport Size (comparing Jan 08–Dec 08 with Jan 09–Dec 09)

Figure 7 shows RI data broken down by the entity that incurred the runway (although this does not imply blame). In the last 12 months, 60% of RIs involved aircraft, 37% involved vehicles and 4% involved people.

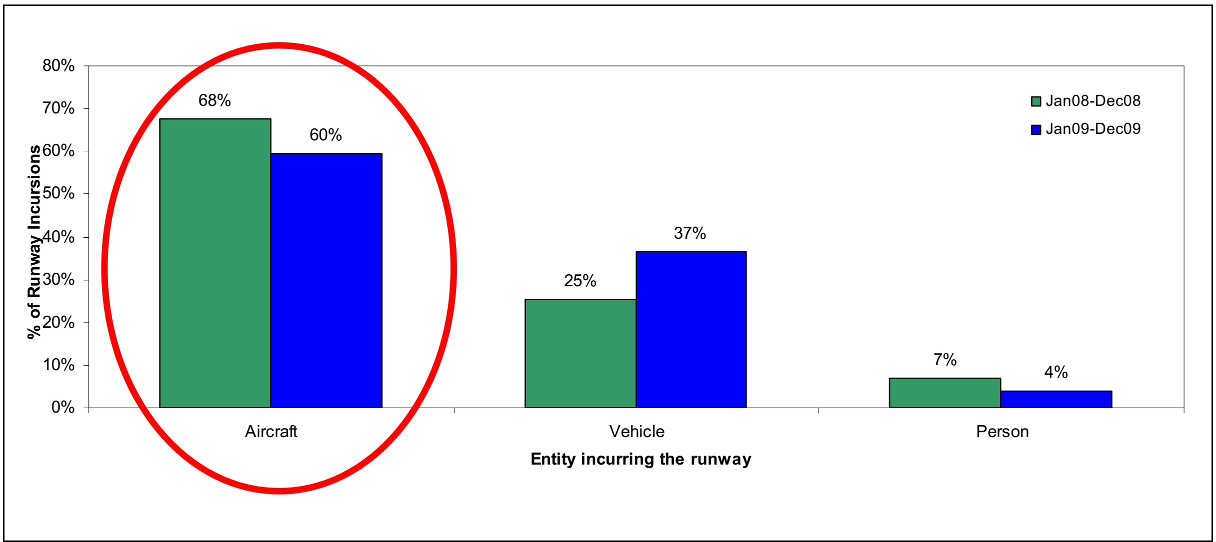


Figure 7 RIs broken down by Entity Incurring the Runway (comparing Jan 08–Dec 08 with Jan 09–Dec 09)

Figure 8 shows a breakdown by weight group for those runway incursions where the incurring entity was an aircraft.

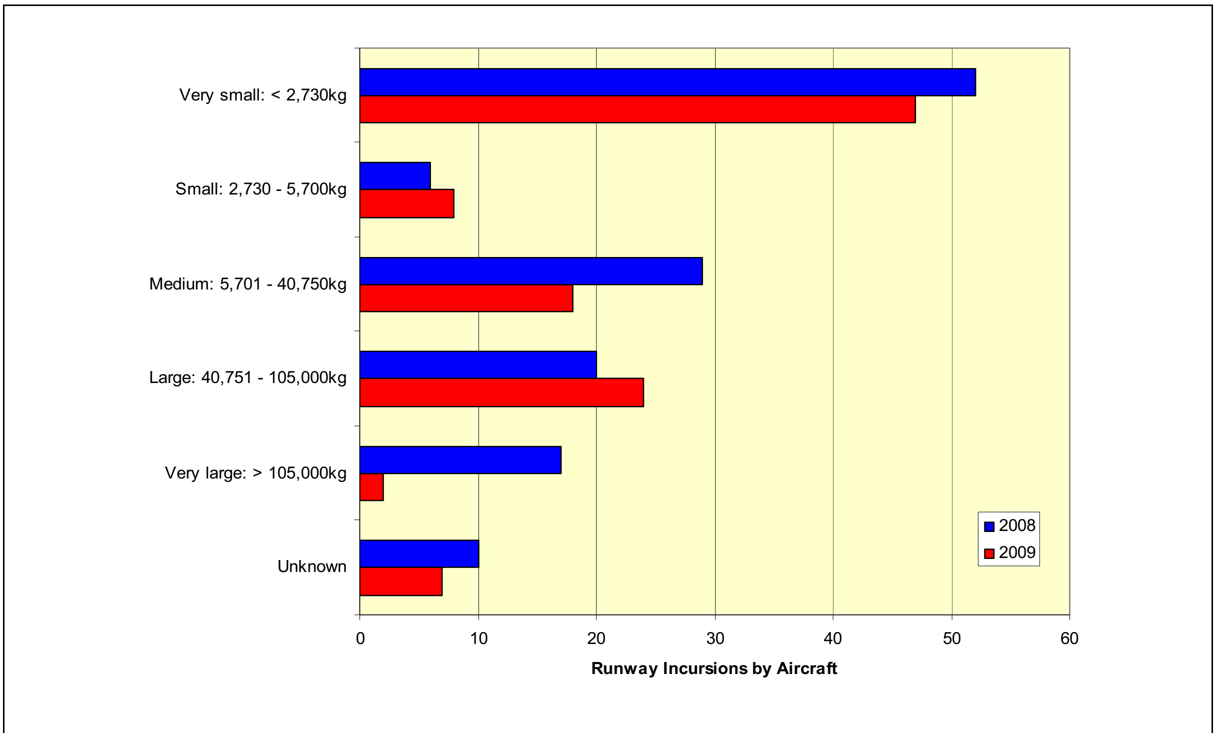


Figure 8 Breakdown of RIs involving Aeroplanes – by Aircraft Size

Figure 9 shows in what way the runway was incurred by the entities shown in Figure 7, in descending order of frequency.

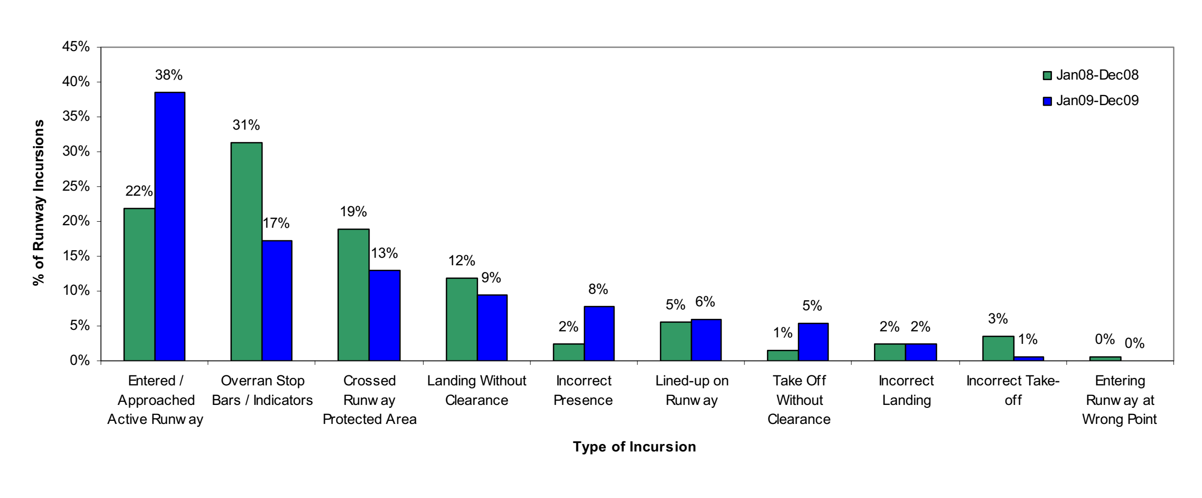


Figure 9 Type of RI (comparing Jan 08–Dec 08 with Jan 09–Dec 09)

The top ten causal factors, using RIs in 2009, were analysed. The contributions of these causes to RIs in 2009 are compared with 2008 in Figure 10.

These factors are neither exhaustive nor mutually exclusive and so the factors can legitimately sum to over or under 100%.

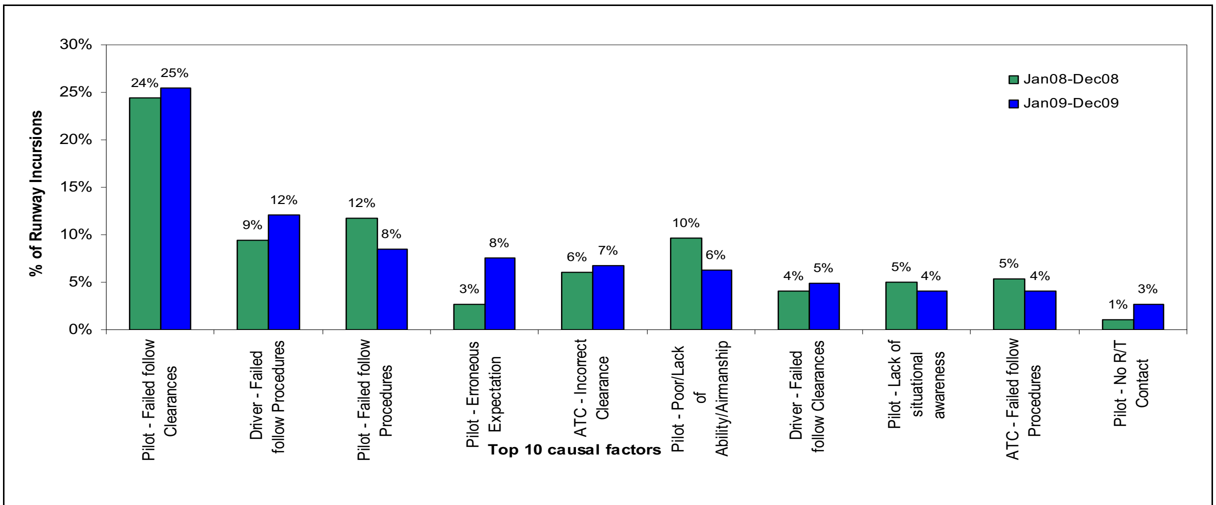


Figure 10 Top-ten Causal Factors (comparing Jan 08–Dec 08 with Jan 09–Dec 09)

Rates of RI

The rate of RIs at all airports that report their air traffic movements to ERG is shown in Figure 11 as a 12-month moving average updated on a quarterly basis.

Utilisation for November and December 2009 has been estimated due to the lag in receiving airport movements from ERG. It has been assumed for these two months that the 10% reduction in traffic, seen last year, comparing 2009 with 2008, has continued.

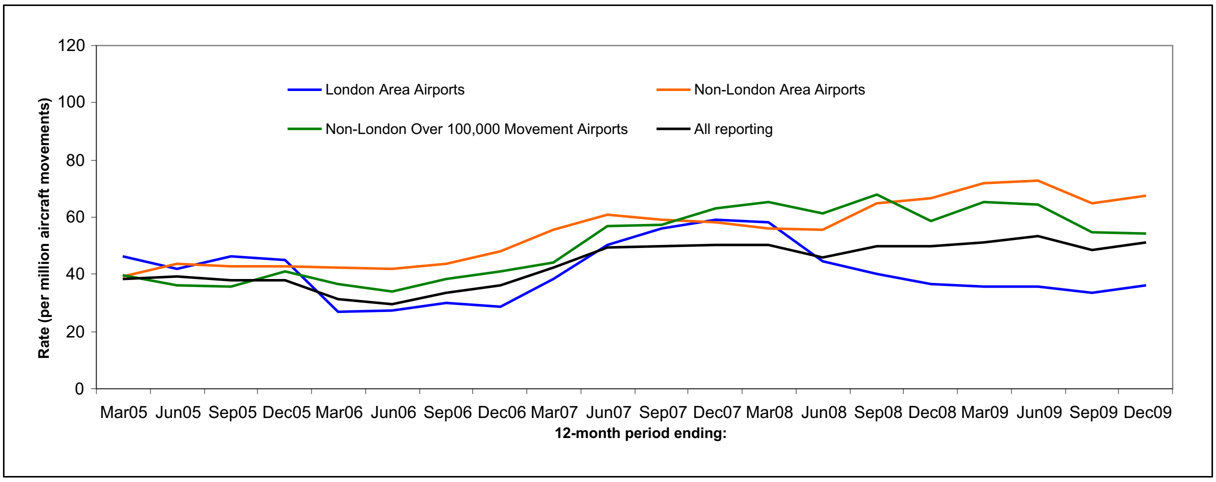


Figure 11 RI rate at Reporting Airports as a 12-month Moving Average

Figure 12 shows the RI rate at airports, grouped according to their number of annual movements.

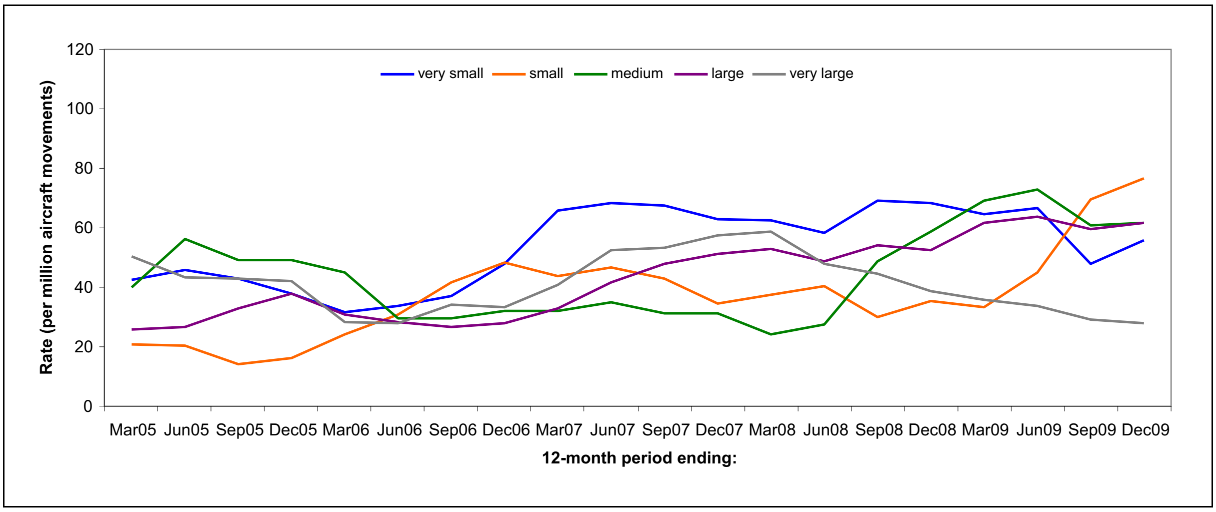


Figure 12 RI rate by Airport's Annual Movements

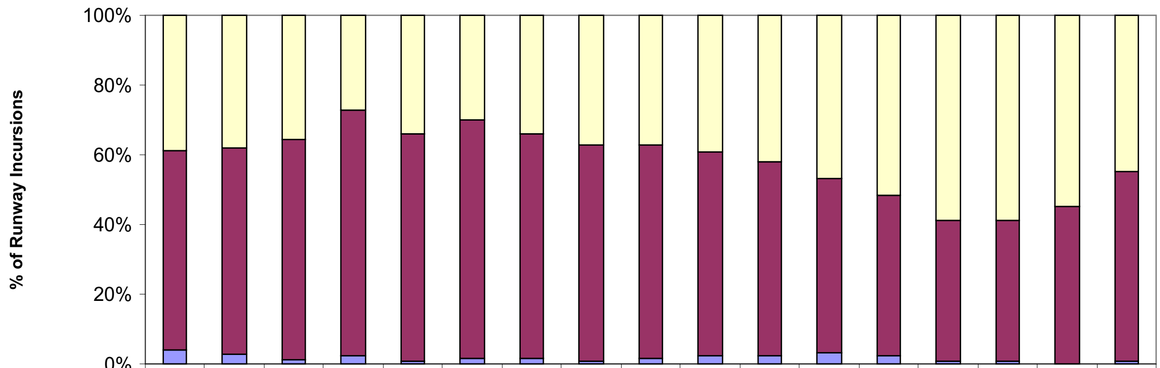
Appendix 2 Runway Incursion Comparison – Light vs Heavy Aircraft

Summary

For light aircraft, the underlying causes are indicative of pilot inexperience, i.e. lack of knowledge of and failure to follow procedures, poor airmanship and erroneous expectation.

For heavy aircraft there is little evidence to suggest there is a single dominant cause of RIs (with the exception of 'pilot – failing to follow clearance' which is more related to the outcome as opposed to the cause); with no major factors contributing towards a significant proportion of the total there is a more even distribution among the causal factors.

Figure 13 shows the number of RIs over the last five years, broken down by light and heavy aircraft. A light aircraft is defined as an aircraft with a MTOW of less than or equal to 5,700 kg and a heavy aircraft is defined as an aircraft with a MTOW greater than 5,700 kg.



	Mar 06	Jun 06	Sep 06	Dec 06	Mar 07	Jun 07	Sep 07	Dec 07	Mar 08	Jun 08	Sep 08	Dec 08	Mar 09	Jun 09	Sep 09	Dec 09	Mar 10
< 5700 kg	30	29	31	24	36	39	47	54	53	48	55	62	65	71	60	58	49
> 5700 kg	44	45	55	62	69	89	90	90	87	72	73	66	58	49	41	48	59
Unknown	3	2	1	2	1	2	2	1	2	3	3	4	3	1	1	0	1

12-month period ending

Figure 13 Number of RIs by Weight

In the absence of the type of operation for a number of aircraft involved in RIs, the data has been grouped in this manner on the understanding that the majority of aircraft flown by the General Aviation community are below 5,700 kg. Equally, it is reasonable to assume the majority of aircraft in the heavy category will be operating as Commercial Air Transport (CAT).

There has been a steady decrease in the number of RIs involving light aircraft since the beginning of 2009 – there have been eight RIs involving light aircraft in the first quarter of 2010 compared with 17 in the first quarter of 2009.

There have been 16 RIs involving heavy aircraft in the first quarter of 2010 compared with five in the first quarter of 2009. The number of RIs per quarter (16) involving heavy aircraft has been constant since June 2009.

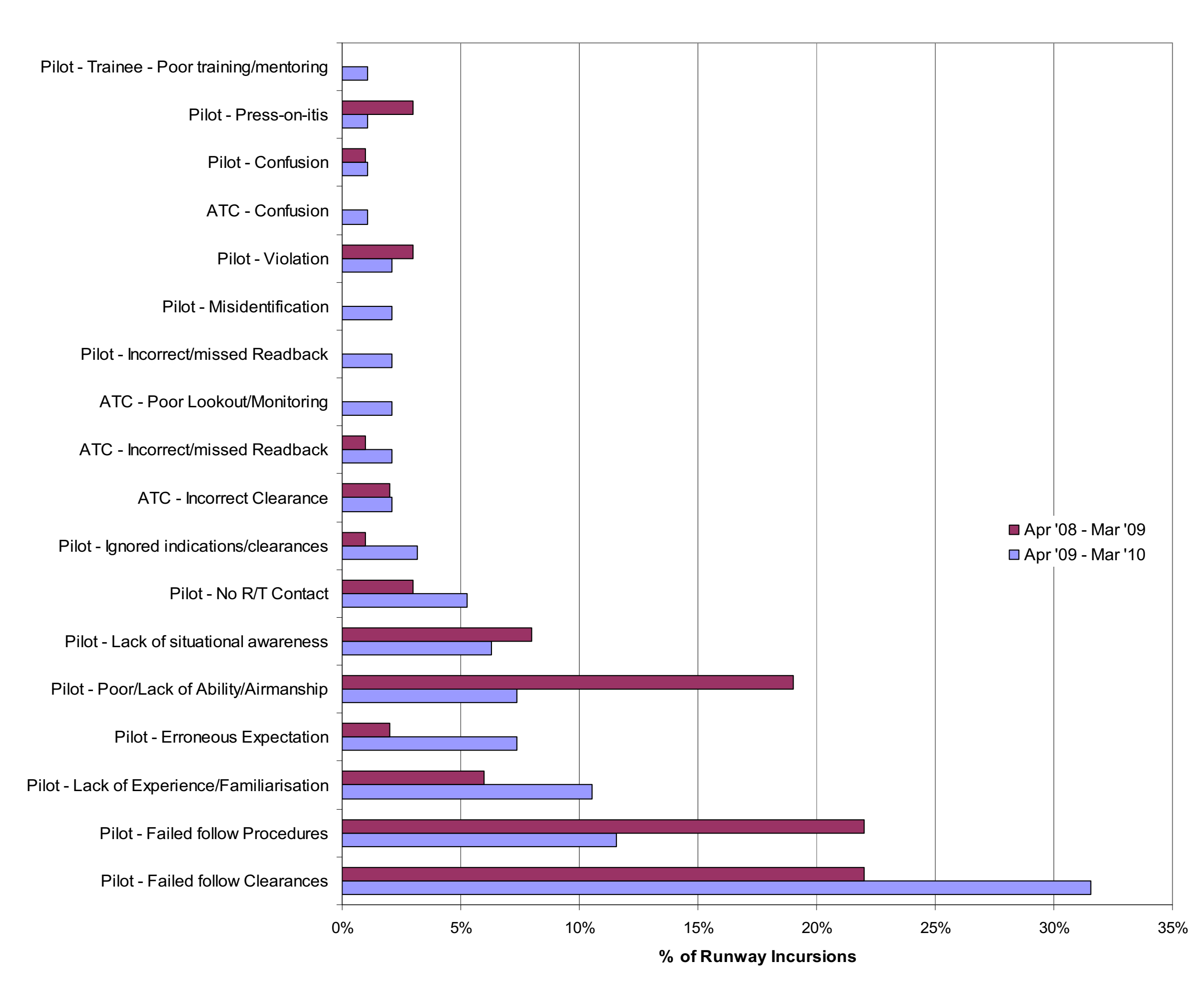


Figure 14 Causal Factors for RIs involving Light Aircraft

Figure 14 shows the percentage contribution of causal factors (allocated by the data subgroup) for RIs involving light aircraft, comparing the April 2009 to March 2010 and April 2008 to March 2009 twelve-month periods.

'Pilot – Failed to follow Clearances', was the number one causal factor (together with 'Pilot – Failed to follow Procedures') for RIs involving light aircraft over the April 2008 to March 2009 period – its overall contribution has increased from 22% in the April 2008 to March 2009 period to 32% in the April 2009 to March 2010 period.

Conversely, the percentage of RIs involving the causal factor 'Pilot – Failed to follow Procedures' have decreased from 22% in the April 2008 to March 2009 period to 12% in the April 2009 to March 2010 period.

Figure 15 shows the percentage contribution of causal factors (allocated by the data subgroup) for RIs involving heavy aircraft, comparing the April 2009 to March 2010 and April 2008 to March 2009 periods.

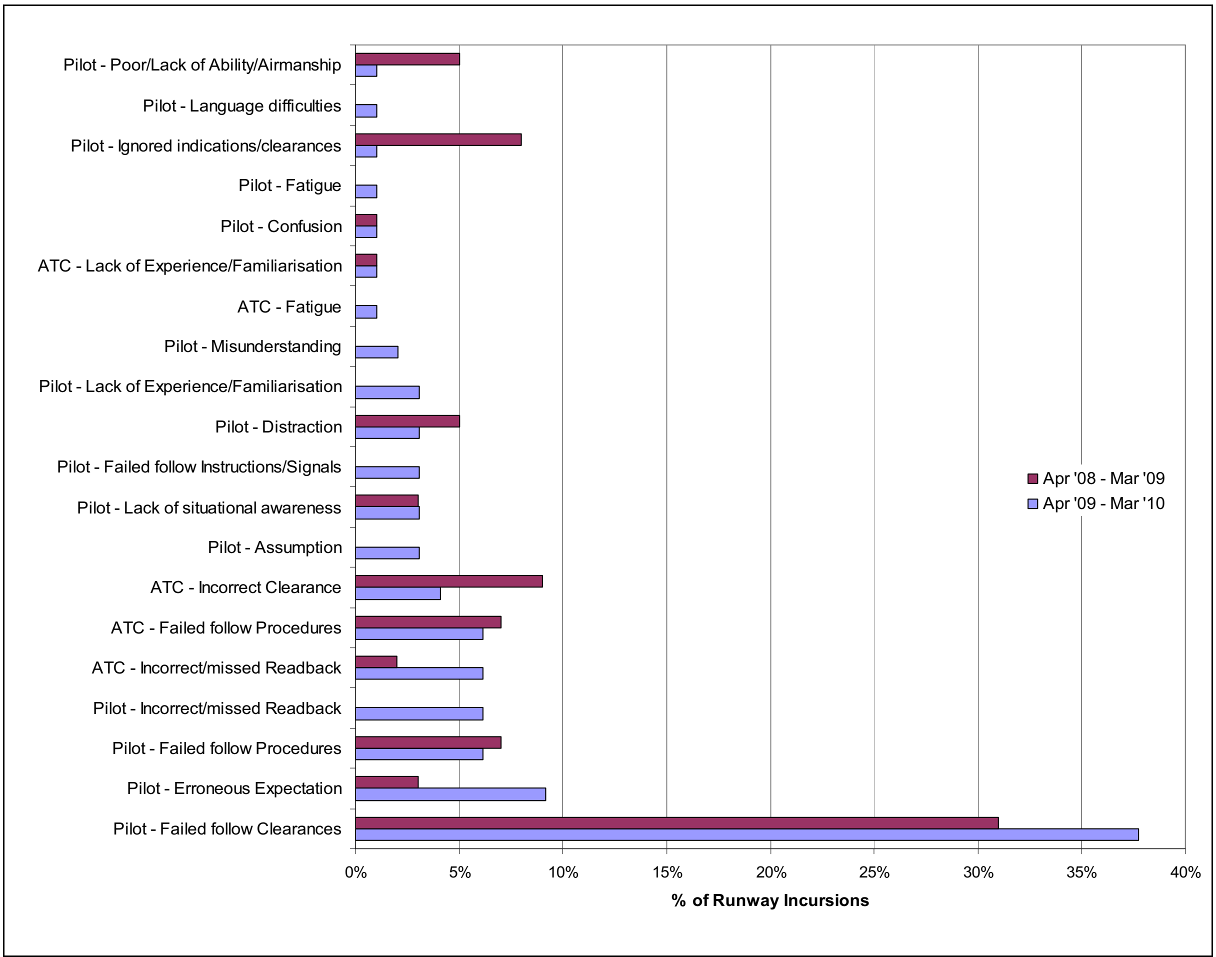


Figure 15 Causal Factors for RIs involving Heavy Aircraft

The number one causal factor for RIs involving heavy aircraft for the past 24 months (April 2008 – March 2010) has been 'Pilot – Failed to Follow Clearances'. This factor's overall contribution has increased from 31% in the April 2008 to March 2009 period to 38% in the April 2009 to March 2010 period.

In the April 2009 to March 2010 period it can be seen that there is a greater prevalence of ATC related causal factors (18%) for RIs involving heavy aircraft than for those involving light aircraft (7%). The data also indicates that 'Pilot – Lack of Experience/Familiarisation' features more in RIs that involve light aircraft – this factor's contribution has increased from 6% for the 12-month period ending March 2009 to 11% for the same period of time ending March 2010. It is also worthy to note that the causal factor 'Pilot – No R/T Contact' for the two-year period April 2008 to March 2010, has only been present in RIs involving light aircraft.

Appendix 3 Recommendations

Task Force: *(use drop-down list)*

Runway Incursions

Recommendation Reference (e.g. LoCTF01):

RITF01

Recommendation Title:

Communication of relevant safety information.

Recommendation Scope: *(tick all that apply)*

Regulatory Change ☐ Guidance Material ☐ Training ☐ Further Study/Research ☐

Procedural Change ☐ Technology ☐ Other Communication

Addressee (e.g. CAA):	If CAA, then Proposed Recommendation Sponsor (CAA Business Area): ***(use drop-down list)***
CAA	All relevant business areas

Justification:

Risk(s) to be Mitigated (both safety and business risks):

If the CAA has knowledge of safety related information and/or data that is not shared with appropriate interested parties or working group partners, then there is a possibility that the authority could be held to account at a future date.

Risk(s) of not Implementing (both safety and business risks):

Technological advances and initiatives may be delayed, poorly co-ordinated or not implemented.

Benefits:

The CAA may benefit from more two-way sharing of information which will enable a better partnership approach with all interested parties. In addition, if information is shared best practice can be identified, reducing the potential for confusion through the proliferation of variations in warnings methods, and nugatory work can be avoided.

Supporting Data:

All relevant information should be shared with interested parties. This will mitigate the risk of the CAA being seen to either not act upon relevant information, or of failing to disclose it. For example, the 2007 "CAA RITSG Study: Technology Assessment" by Helios Technology should be shared with all RISG members (both internal and external) and NATS.

Task Force: *(use drop-down list)*

Runway Incursions

Recommendation Reference (e.g. LoCTF01):

RITF02

Recommendation Title:

Engagement with Industry and Stakeholders.

Recommendation Scope: *(tick all that apply)*

Regulatory Change ☐ Guidance Material ☐ Training ☐ Further Study/Research ☐

Procedural Change ☐ Technology ☐ Other Engagement

Addressee (e.g. CAA):	If CAA, then Proposed Recommendation Sponsor (CAA Business Area): ***(use drop-down list)***
CAA	All relevant business areas

Justification:

Risk(s) to be Mitigated (both safety and business risks):

If the CAA is seen as an organisation that does not engage with either industry or with aviation partners, including international players, then it is likely that these bodies will forge ahead with their own agenda, leaving the CAA in a position where influencing opportunities become limited

Risk(s) of not Implementing (both safety and business risks):

A disparate approach by different groups may lead to pilot confusion through a proliferation of warning methods, duplication of effort and nugatory work.

Benefits:

The CAA may benefit from more two-way sharing of information which will enable a better partnership approach with all interested parties.

Supporting Data:

RISG should continue to engage closely with AOC operators, General Aviation (GA), Airports and Air Traffic Service providers. Recent engagement with AOC holders on RI issues is proving to be effective, and is seen by industry as a welcome approach. RISG should review existing engagement mechanisms, and from there identify what improvements should be made.

Task Force: *(use drop-down list)*

Runway Incursions

Recommendation Reference (e.g. LoCTF01):

RITF03

Recommendation Title:

Analysis and investigation of Low-Risk / High-Frequency reports.

Recommendation Scope: *(tick all that apply)*

Regulatory Change ☐ Guidance Material ☐ Training ☐ Further Study/Research ☒

Procedural Change ☐ Technology ☐ Other

Addressee (e.g. CAA):	If CAA, then Proposed Recommendation Sponsor (CAA Business Area): ***(use drop-down list)***
CAA	Group Safety Services

Justification:

Risk(s) to be Mitigated (both safety and business risks):

Low-risk events are often the subject of little or no further analysis or investigation, even if such events occur on a regular basis.

Risk(s) of not Implementing (both safety and business risks):

Whilst low-risk events may be considered to be not worthy of investigation, if they occur in high numbers, then there may be very little between the low-risk event that is trapped, and an event which leads to a more serious incident. Analysis of factors involved in low-risk events would provide early indications of increasing risk areas.

Benefits:

By analysing and investigating these events, the CAA can be better informed on causal factors and developing trends.

Supporting Data:

There needs to be some analysis regarding low-risk but high frequency events, as these may help to better inform us on overall trends and common causal factors, in order that early action can be identified.

It may be possible to increase the quality and amount of information we receive in individual MORs, particularly since all runway incursions do undergo an investigation of sorts by the data subgroup – with causal factors being allocated to all incursions.

Task Force: *(use drop-down list)*

Runway Incursions

Recommendation Reference (e.g. LoCTF01):

RITF04

Recommendation Title:

CAA to take more of a visible lead on Runway Safety.

Recommendation Scope: *(tick all that apply)*

Regulatory Change ☐ Guidance Material ☐ Training ☐ Further Study/Research ☐

Procedural Change ☐ Technology ☐ Other Engagement

Addressee (e.g. CAA):	If CAA, then Proposed Recommendation Sponsor (CAA Business Area): ***(use drop-down list)***
CAA	Aerodrome Standards and Flight Operations

Justification:

Risk(s) to be Mitigated (both safety and business risks):

At present, there is some evidence that the CAA is not seen by industry as taking a lead on this subject.

Risk(s) of not Implementing (both safety and business risks):

The CAA may become sidelined by existing working groups, and therefore be unable to influence to a useful extent

Benefits:

A more joined-up national approach may help to bring together different groups with the aim of achieving a deliverable outcome which will benefit operators, aerodromes and ANSPs alike

Supporting Data:

Discussions with AOC holders indicate that there is sometimes confusion amongst operators regarding where the CAA fits into the overall Runway Safety picture, and who is taking the lead on this subject. However, the current engagement initiative is starting to bear fruit, and should be continued.

Task Force: *(use drop-down list)*

Runway Incursions

Recommendation Reference (e.g. LoCTF01):

RITF05

Recommendation Title:

Follow-up of AAIB recommendations.

Recommendation Scope: *(tick all that apply)*

Regulatory Change ☒ Guidance Material ☒ Training ☒ Further Study/Research ☒

Procedural Change ☒ Technology ☒ Other

Addressee (e.g. CAA):	If CAA, then Proposed Recommendation Sponsor (CAA Business Area): ***(use drop-down list)***
CAA	All relevant business areas

Justification:

Risk(s) to be Mitigated (both safety and business risks):

There is some concern that AAIB recommendations are not always followed-up by those to whom the recommendation is addressed. There is no formal follow-up procedure for AAIB recommendations which means that similar incidents or events can re-occur due to recommendations being ignored, misunderstood or rejected. AAIB recommendations are an invaluable source of information from which others can also learn.

Risk(s) of not Implementing (both safety and business risks):

Important safety lessons may be missed and similar events may re-occur within the original organisation or at others. Actions taken to address the issues identified are also vital sources of lessons for others to consider.

Benefits:

It may be the case that 'lessons learned' could prevent future occurrences of a similar nature.
Note: This recommendation could be applied to all task force areas.

Supporting Data:

When the AAIB makes recommendations, there should be follow-up action to ensure that any safety recommendations are acted upon, either by aircraft operators, ANSPs or Aerodrome Operators. Whilst the AAIB always publishes its recommendations, it may be that the audience for these is limited, as are the actions taken to address the recommendations. Any recommendations should be pursued to ensure that action is taken as recommended, or an alternative course of action is agreed.

Task Force: *(use drop-down list)*

Runway Incursions

Recommendation Reference (e.g. LoCTF01):

RITF06

Recommendation Title:

Communication of Local Runway Safety Team information.

Recommendation Scope: *(tick all that apply)*

Regulatory Change ☐ Guidance Material ☐ Training ☐ Further Study/Research ☐

Procedural Change ☐ Technology ☐ Other Communication

Addressee (e.g. CAA):	If CAA, then Proposed Recommendation Sponsor (CAA Business Area): ***(use drop-down list)***
LRSTs	N/A

Justification:

Risk(s) to be Mitigated (both safety and business risks):

There is some evidence that the Local Runway Safety Team information is not widely utilised at the aerodrome concerned or amongst other aerodromes.

Risk(s) of not Implementing (both safety and business risks):

Vital runway safety information and best practice could be missed by airport authorities, airlines and airline service providers.

Benefits:

By sharing the information, there is a greater chance that RI numbers will be reduced.

Supporting Data:

Individual aerodrome runway safety issues are discussed on a regular basis at the Local Runway Safety Meetings. This information is not always disseminated to those that would benefit from it. This may be due to lack of operator staff availability, lack of awareness of these meetings, or poor communication. Procedures to widen the flow of information should be explored.

Task Force: *(use drop-down list)*

Runway Incursions

Recommendation Reference (e.g. LoCTF01):

RITF07

Recommendation Title:

Mitigating the risks of Runway Incursions, and of Ground Collisions.

Recommendation Scope: *(tick all that apply)*

Regulatory Change ☐ Guidance Material ☐ Training ☐ Further Study/Research ☒

Procedural Change ☐ Technology ☐ Other

Addressee (e.g. CAA):	If CAA, then Proposed Recommendation Sponsor (CAA Business Area): ***(use drop-down list)***
CAA	Group Safety Services

Justification:

Risk(s) to be Mitigated (both safety and business risks):

Ground Collisions: The available data suggests that this is a very low-risk area within the UK. However, it is recommended that data for worldwide ground collisions involving G-registered aircraft is reviewed before any further recommendation is made. Airfield design is a key factor in ground collision avoidance and this aspect must be assessed during new works at airports.

RIs: Work in this area continues. It is recommended that data for worldwide RI incidents involving G-registered aircraft is explored (if available), in order that any common causal factors can be identified

Risk(s) of not Implementing (both safety and business risks):

Ground Collisions: Nil.

RIs: The number of RIs will increase, possibly with severe consequences.

Benefits:

Ground Collisions: Complete data for UK-registered aircraft will help more accurately to identify trends and causal factors, including future airport manoeuvring area design changes.

RIs: Complete data for UK-registered aircraft will help more accurately to identify trends and causal factors.

Supporting Data:

Appendices 1 and 2.

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Report 5 Airborne Conflict Task Force

Executive Summary

The Airborne Conflict Task Force (ACTF) was formed as one of seven task forces set up to monitor and develop initiatives to mitigate the top safety risks identified during the generation of the 2009/2011 CAA Safety Plan. The ACTF was formed in August 2009 and held its first meeting on 3 September 2009.

The key tasks of the ACTF were to review work already completed or underway in the area of airborne conflict, undertake a systematic analysis of the risks, determine a Safety Performance Indicator to monitor the risks and to develop new strategies for monitoring and reducing the risks.

This report presents the work undertaken and includes recommendations for ongoing activities to be considered for the Safety Improvement Programme which were presented at the Safety Conference in October 2010 and for the 2011 CAA Safety Plan.

1 Introduction

1.1 The CAA's safety risk management process was reviewed during the generation of the 2009/2011 Safety Plan and in preparation for the 29 January 2009 Safety Conference. This review identified seven top safety risks.

1.2 On completion of the Safety Conference, the Safety Risks Team (SRT) reviewed proposals on how task forces would tackle the seven risks and any other more tactical risks arising from the work of The High Risk Events Analysis Team (THREAT) or topical events arising from recent accidents, significant occurrences or Air Accidents Investigation Branch (AAIB) recommendations.

1.3 This report presents the work of the ACTF.

2 Airborne Conflict Task Force

2.1 The ACTF was formed in August 2009 and held its first meeting on 3 September 2009. It then met on a monthly basis. The Terms of Reference (ToRs) for the task force are provided in Appendix 1 and a list of the membership is given in Appendix 2. The deliverables set in the ToRs were later amended by the SRT to reflect revised thinking regarding a follow-up Safety Conference.

2.2 The key tasks of the task force were:

- To review work already completed or underway in the area of airborne conflict, both within the CAA and externally. In particular:
  - Safety Performance Indicator (SPI) 2 recommendations;
  - Mid-Air Collision Fishbone Working Group recommendations;
  - THREAT analysis 2005-2008.
- To undertake a systematic analysis of the risks.
- To determine an SPI to monitor the risks.
- To develop new strategies for monitoring and reducing the key risks.

These are reviewed in turn below.

3 Review of Existing Work

3.1 SPI 2 Recommendations

3.1.1 An action from the Safety Conference held in January 2009 was to form a joint CAA-industry working group to identify why Safety Performance Indicator 2 (SPI 2) was increasing and what could be done to remedy the situation. A group consisting of experts from the CAA, UK airline industry, AAIB and NATS was formed in April 2009 with a remit to 'brain storm' the issue.

3.1.2 The SPI 2 Working Group (SPI 2 WG) made 18 key recommendations, with some broken down into part recommendations, the majority of which were allocated to the task forces. Of these, nine were allocated to the ACTF and the ACTF positions on these are summarised in Appendix 3.

3.1.3 Of the nine SPI 2 WG recommendations allocated to the ACTF, it is proposed that seven can be closed on the basis of actions completed or work that is underway. The two remaining items have been developed into ACTF Recommendations.

3.2 Mid-Air Collision Fishbone Working Group (MACFWG) Recommendations

3.2.1 As part of the Safety Planning process in 2005, there was a cross-divisional top-down analysis of the six major risks to large public transport aeroplanes. One of the identified risks was mid-air collision. A number of recommendations that were not taken up in the CAA Safety Plan were allocated to the ACTF for further consideration. The ATCF positions on these are given in Appendix 4.

3.2.2 Of the eight MACFWG recommendations considered by the ATCF it is proposed that seven are closed on the basis of actions completed or work that is underway. The remaining item has been developed into an ACTF Recommendation.

3.3 Threat Analysis 2005-2008 Observations

3.3.1 Generic Observation 2008-03 addresses the use of National (Non-ICAO Approved) language at foreign international airports contributing to confusion for non-National operators, and recommends the lobbying of EUROCONTROL for an international agreement amongst EUROCONTROL States that English should be the only language used at international airports. If successful, it further recommends this being extended outside of Europe.

3.3.2 This generic observation was allocated to the ACTF and the Runway Incursion and Ground Collision task force, particularly with respect to risks affecting UK-operated aircraft outside of EUROCONTROL airspace. This is also the subject of SPI 2 WG Recommendation 10, see Appendix 3.

3.4 Other Working Groups and Committees

3.4.1 Many groups and committees within CAA and externally are working to reduce the risk of airborne conflict by focussing on the precursor events, such as level busts and airspace infringements. A summary of these groups is given in Appendix 5. Key groups and initiatives are the UK Level Bust Working Group (LBWG), Airspace Infringement Working Group (AIWG), Airspace & Safety Initiative (ASI) Airborne Collision Avoidance Systems (ACAS) Working Group, Air Traffic Services Outside Controlled Airspace (ATSOCAS) and the Business Aviation Safety Partnership (BASP). These are discussed in turn below.

3.4.2 **UK LBWG.** This is a well-established group that is co-chaired by the CAA (Flight Operations) and NATS (Safety Investigations). The group has been responsible for many successful safety initiatives since the publication of *CAP 710 Level Bust Working Group 'On the Level' Project Final Report*. A change in strategy has recently been agreed and work will now focus on the airspace interactions where the likely outcome of a level bust could be catastrophic. In addition, an ambitious work programme of concurrent activity has been agreed and will commence shortly.

3.4.3 **AIWG.** This is also a long-established working group that, whilst predating the ASI by several years, is an ASI sub-group co-chaired by the CAA's Directorate of Airspace Policy (DAP) and SRG Flight Operations Inspectorate (General Aviation). The group consists of representatives from DAP, SRG, NATS, MoD and GA and has been responsible for carrying forward the findings of the On Track report (CAA *Paper 2003/05*) and numerous infringement initiatives. A definitive AIWG Action Plan has been drafted and, following ratification by AIWG members, will be implemented shortly. AIWG is closely linked to the activities of the ASI Communications and Education Programme (ACEP).

3.4.4 **ASI ACAS WG.** This is a CAA sponsored group chaired by the CAA's DAP and includes representatives from SRG, NATS and MoD. The group's purpose is to monitor ACAS developments and issues arising from the use of ACAS and non-ACAS Collision Warning Systems (CWS) by all categories of pilot in all classes of aircraft. Having considered statistical or other evidence, including pilot reports, the group will make recommendations and take action through its members to alleviate potential problem areas. These recommendations may be UK-wide, site-specific or user-specific.

3.4.5 **ATSOCAS.** A review of ATSOCAS was initiated by the CAA as a direct response to AAIB and AIRPROX reports that raised concerns about the lack of standardisation of service delivery and the confusion that this caused. This culminated in revised ATSOCAS, as promulgated in *CAP 774 UK Flight Information Services* being implemented in March 2009, supported by a wide-ranging education and publicity campaign.

A six-month post implementation review was undertaken during Autumn 2009. This established that the introduction of the revised air traffic services had gone well and that there had been relatively few adverse comments, none of which were of a significant nature. It was not considered necessary to make any further policy change; however, several areas were identified where minor enhancements could be made to *CAP 774*. These were published as a part of Amendment 1 in November 2009.

When the ATSOCAS project plan was first proposed in 2004, a Phase 5 was annotated as 'review' without any further amplification. Consequently, options for this phase have been presented to the ASI ATM Standards Working Group (ATMSWG) who agreed that a further review would be conducted as a joint CAA/MoD two-person regulatory exercise, with a report produced by the end of July 2010. The review was to include the following activities:

- Continued maintenance of the ATSOCAS feedback mechanism on the ASI website, and consideration of comments received
- Continuing analyses of MOR and AIRPROX data to establish any new trends and identify any areas where further action may be required
- Evaluation of, and update to, the recommendations made in the ATSOCAS Initial Report, which encompassed areas beyond the development and publication of revised air traffic services and associated procedures

The implementation of revised ATSOCAS can be considered to have been a clear success, which has generated wide-ranging improvements beyond purely the standardisation of services. This can be primarily attributed to the collaborative cross-CAA/MoD/Industry commitment to the change.

3.4.6 **BASP.** This is a recently established group chaired by CAA Flight Operations working in close co-operation with a wide range of stakeholders in the business aviation community. The ethos of the group is to work holistically in the development of strategies designed to achieve incremental improvements in the safety standards of this complex, diverse sector of the aviation industry. In addition, the group provides an effective vehicle for the CAA to facilitate the development of industry initiated safety improvements, a recent example being the Emergency Response Planning guidance published by the European Business Aviation Association (EBAA). Close working relations are being fostered with key organisations representing business aviation interests such as the EBAA and the International Business Aviation Council (IBAC).

3.4.7 It can be seen from the above that the ACTF has had to be cognisant of the work of numerous groups working to address the precursors to an airborne conflict event to avoid duplicating/countering work already underway elsewhere. This has influenced the ACTF's way of working in that it sought to take into account the work of these other groups to identify past, present and future activity and then sought to focus on specific areas where a difference might be made through specific ACTF activity. An example of the success of this approach has been in the identification of a specific issue that would appear to have been missed elsewhere. It has become apparent that confusion exists amongst pilots and the ATC community about the correct response to an ACAS Resolution Advisory (RA) in the turn. Where specific issues (such as this) have been identified that should, quite properly, be addressed by another group (in this case the ACAS WG), the matter will be handed over for further development.

4 Systematic Analysis of Risks Relating to Airborne Conflict

4.1 Background Analysis

4.1.1 Prior to the formation of the ACTF, the Accident Analysis Group (AAG) analysed fatal mid-air collisions during the period 1997–2008. There were four fatal accidents, all outside of the UK. Details of these events can be found in Appendix 6.

4.1.2 Furthermore, an analysis of airborne conflict events was conducted by THREAT. During the four-year period considered (2005–2008), 27 events were reviewed by the group. Details of these events can be found in Appendix 7. One of the main findings of the analysis of these events was the significant proportion of them that took place outside of UK airspace – 70% (19 out of 27).

4.1.3 This high proportion of airborne conflict events abroad led the ACTF to focus its more in-depth analysis on airborne conflict risk to *outside* UK airspace.

4.2 Expanded Analysis

4.2.1 An expanded dataset was reviewed by the ACTF, consisting of low severity (MOR Grades C + D) airborne conflict events in addition to the high-severity events (MOR Grades A + B) analysed by THREAT. The dataset considered:

- events during the period 2005–2009;
- events involving UK-registered/operated aeroplanes;
- aircraft with a Maximum Take-off Weight Authorised > 5,700 kg;
- aircraft operating as UK Commercial Air Transport (CAT);
- events taking place *outside* of UK airspace.

4.2.2 A total of 298 events were analysed:

Year	Number of Events
2005	56
2006	47
2007	71
2008	67
2009	57

The analysis of these events considered their location, phase of flight and type of conflict (e.g. CAT v Military or CAT v CAT). Full details of the analysis can be found in Appendix 8. The main findings of the analysis were:

- 199 (67%) of the events took place within Europe, 42 (14%) in Africa and 32 (11%) in North America
- Almost half the events (47%) took place in three countries: 71 (24%) in Spain, 40 (13%) in France and 30 (10%) in the USA.
- The majority of airborne conflict events were found to occur during arrival and departure: 139 (47%) during approach/descent and 69 (23%) during climb. One notable exception to this was found: the majority of airborne conflict events over Africa were found to take place during the cruise (50%)
- In 188 (63%) events the operation type of the conflicting aircraft was not known. Where the nature of flight of the second conflicting aircraft was known, passenger flights were found to account for 33%

4.3 Application of Barrier Model

4.3.1 In addition a 'barrier model' was applied to the dataset which considered, for each event, which barrier was successful in resolving the conflict and prevented it from becoming a mid-air collision. The following barriers were applied: ATC Procedures, Flightdeck Procedures, ACAS RAs and Providence. Definitions of these barriers and how they were applied can be found in Appendix 9.

4.3.2 At the time of compiling this report, 223 of the 298 events had been reviewed and for each event a 'resolving' barrier had been allocated. For seven events it was not possible to allocate a barrier due to a lack of information. The effectiveness of each barrier for the remaining 216 events is summarised in Figure 1.

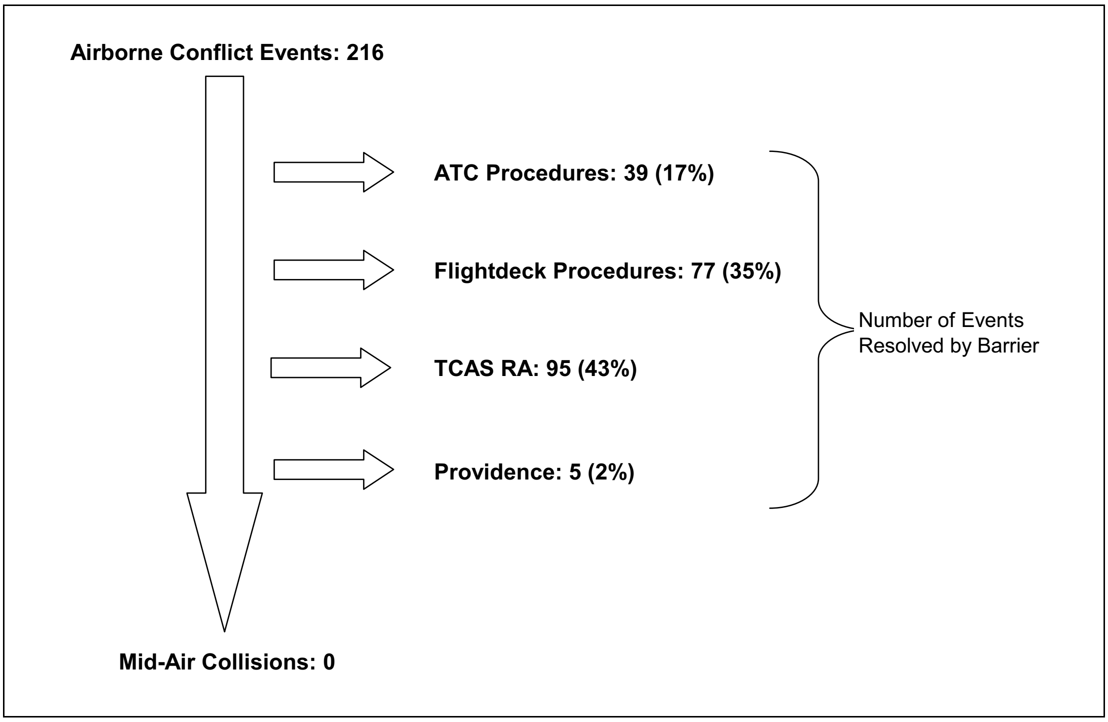

Figure 1 Application of Barrier Model to Airborne Conflict Events

4.3.3 The barrier model has been used as the basis for an SPI to measure airborne conflict risk outside the UK (this is described further in Section 5).

4.3.4 Application of the barrier model revealed the following:

- TCAS Resolution Advisories are the most effective barrier in resolving airborne conflicts, resolving 95 (43%) of the conflicts analysed.
- For the vast majority of events resolved by ATC procedures, it is not known whether the resolution was by:

  a) timely and effective controller action; or

  b) action from the controller prompted by technological aids, such as STCA.

  Avoiding action given to the flight crew from the controller could be a result of a) or b) and since the flight crew are typically not aware which, this information would not be contained in their Air Safety Report.
- 77 events were resolved by Flightdeck Procedures and of these, almost half of the resolutions were aided by enhanced situational awareness provided by traffic displayed on TCAS.
- TCAS (providing RAs or as an aid to increasing situational awareness) contributed to the resolution of a significant number of events – 130 (58%) out of the 223 events.

4.4 Analysis Summary

4.4.1 The greatest risk of airborne conflict exists outside the UK, primarily during approach and departure, although over Africa the risk is greater during the cruise.

4.4.2 Using Air Safety Reports from flight crew the barrier model has successfully been applied to airborne conflict events outside the UK, despite the absence of information from Air Navigation Service Providers (ANSPs) in the vast majority of cases. Nevertheless, information from ANSPs would be beneficial to aid analysis.

4.4.3 The most effective barrier in the resolution of conflicts is correctly following ACAS RAs, which supports the need for effective flight crew training in response to RAs.

5 Safety Performance Indicators

5.1 A range of SPIs, produced by Strategic Analysis, are reported to the SRG Executive Committee on a quarterly basis. Of these, a number are linked with airborne conflict and mid-air collision risk, but no single SPI provides an indication of the overall risk.

5.2 Ideally a single indicator would provide an indication of overall airborne conflict risk for flights in UK airspace and/or flights by UK operators. However, given the varying nature of the airspace that aircraft operate through (controlled/uncontrolled with varying/no separation minima) and the variation in the availability of information from occurrence reports, e.g. availability of reports from ANSPs in different airspace, the use of a single SPI is not practicable. Also, there is a wide range of possible precursor events.

5.3 Three Tier 2 (see Appendix 10) SPIs are proposed by the ACTF to monitor the risk of airborne conflict / mid-air collision:

- UK-Controlled Airspace: Loss of Separation Events;
- UK Uncontrolled Airspace: AIRPROX assessed/classified by UKAB;
- Non-UK Airspace: AIRPROX/Airborne Conflict Events assessed using the barrier model described in Section 4.3.

5.3.1 Further to these SPIs, Tier 3 SPIs could be developed which can be monitored at an operational level by industry. In addition, these SPIs would be complemented by monitoring particular event types, such as level busts and airspace infringements. Examples of the proposed SPIs follow (see Figures 2 to 4).

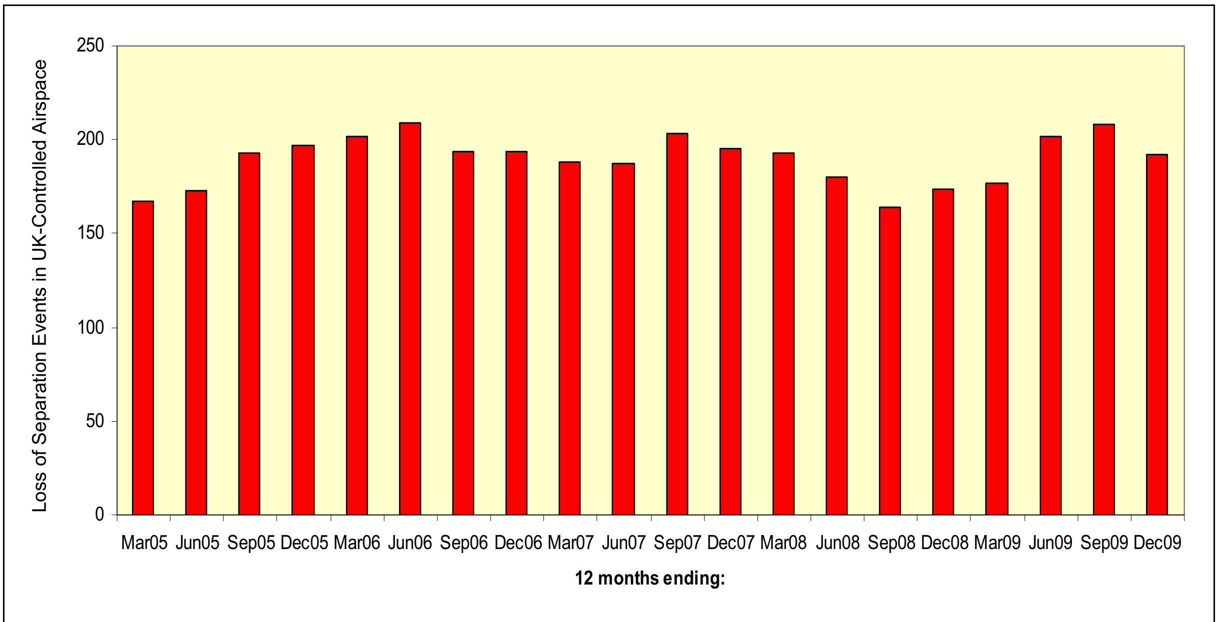

Figure 2 UK-Controlled Airspace: Loss of Separation Events

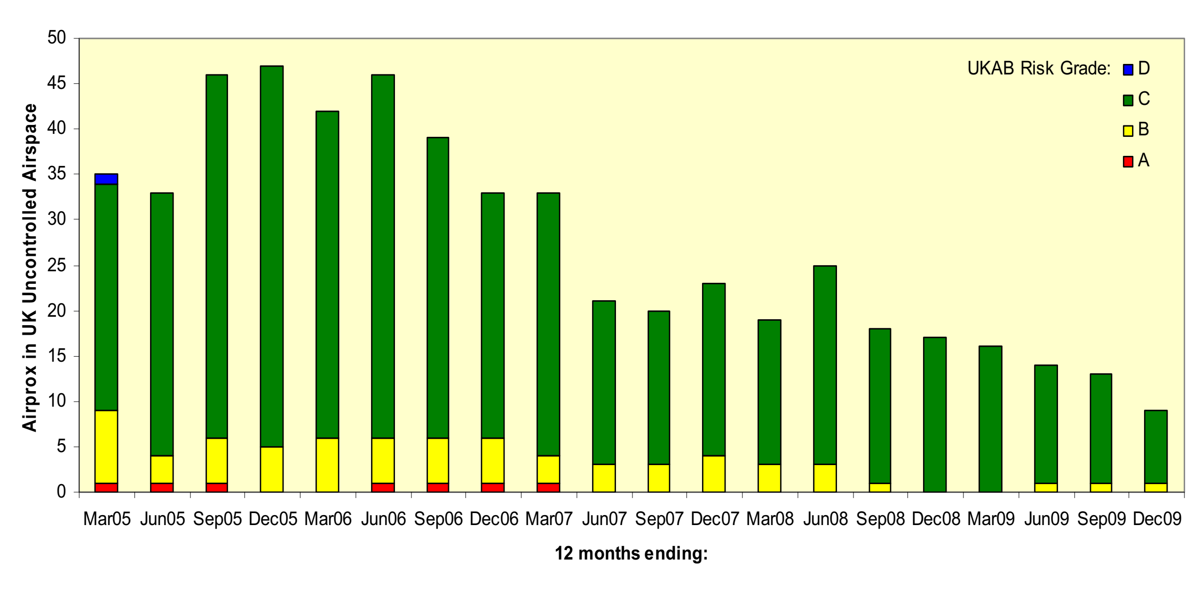

Figure 3 UK Uncontrolled Airspace: AIRPROX assessed and classified by UKAB

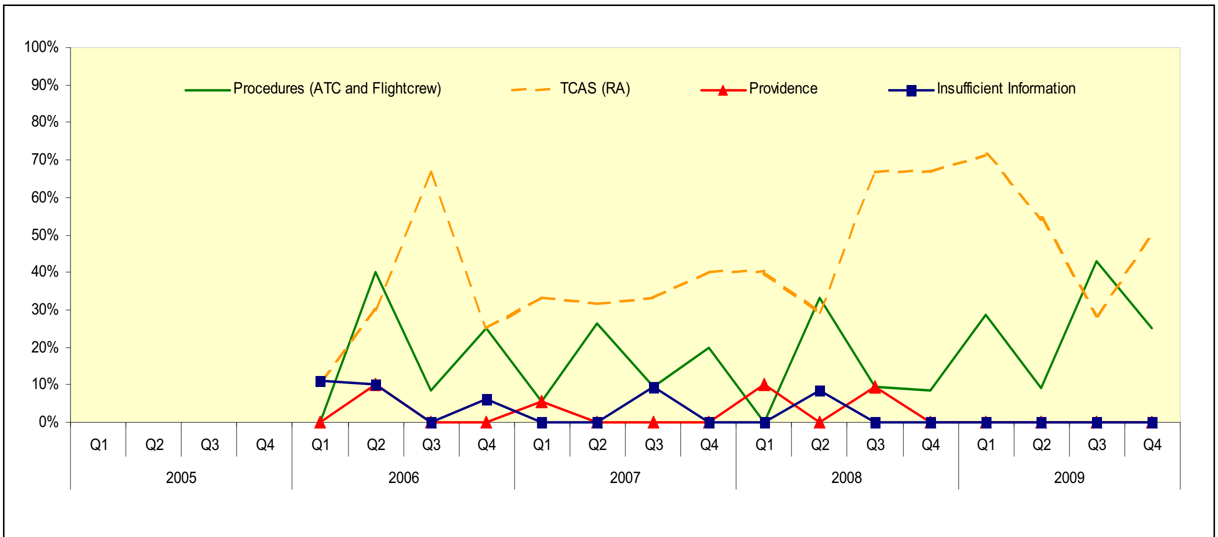

Figure 4 Non-UK Airspace: AIRPROX / Airborne Conflict Events assessed using a barrier model (% contribution of barriers that resolved events)

6 New Strategies

6.1 ACAS Training

Statistics have indicated that pilot response to ACAS RAs is, to a significant extent, unreliable. EUROCONTROL monitoring indicates that only 56% of RAs have been correctly followed, with non-Commercial Air Transport operators featuring among the balance of incorrect responses. Whilst guidance for ACAS training has been offered both by 'Skybrary' and the CAA, it remains for operators to reinforce the performance of ACAS RAs by targeted training incorporating robust examination of correct responses in terms of rate and pitch sense and, where training devices are so equipped, providing training of RAs whilst established in turns or at high aircraft mass/ altitude combinations. The emphasis, however, must be upon CORRECT response time and, at the very least, discussion of the flying of RAs from situations that until now have not been consistently and effectively trained. It has become apparent from informal sampling that there is no extant guidance available to operators for the response required to an ACAS RA received whilst in a turn. The use of part-task/desktop training aids should be encouraged

ATCF Position: EUROCONTROL monitor the quality of pilot responses to ACAS events and publish their findings regularly. CAA Flight Operations should review the EUROCONTROL data and appropriate follow-up action should be undertaken to ensure appropriate and timely crew responses to ACAS events across industry. CAA Training Standards should sample the quality of Simulator ACAS training and establish the range of capabilities of devices to simulate realistic ACAS event scenarios, and ensure that operators are aware of the potential of each simulator in this regard. CAA Training Standards should clarify where the definitive source of guidance for ACAS training now lies given that it is believed that Joint Aviation Authorities (JAA) *Temporary Guidance Leaflet (TGL) 11* is no longer extant. Similarly, efforts should be made to amend ICAO *Doc 8168 Aircraft Operations* to cover these issues adequately. **(Recommendation ACTF01)**

6.2 Strategic Lateral Offset Procedures (SLOP)

These are procedures in ICAO PANS-ATM designed for use in oceanic/remote airspace. Implemented in 2004, the procedures distribute traffic following a routing across a two-mile wide area to the right of the course centreline. Over the past five years, the use of SLOP has progressively reduced the lateral overlap probability in North Atlantic RVSM airspace and in doing so has contributed to a lessening in the vertical collision risk. However, as it is implemented on a voluntary basis, it has not had the desired effect of spreading the traffic evenly across the three available lateral positions.

Six years after adoption in the North Atlantic, take-up is slow with 61% of aircraft still flying on track. The UK has now made proposals to ICAO to mandate offsets by flight level and, in doing so, increase the rate of take-up and increase vertical separation. This proposal has been forwarded through the ICAO North Atlantic groups and was due to be considered by the North Atlantic Systems Planning Group in June 2010. The CAA proposal ensures not only lateral separation from adjoining flight levels but also a 3,000 ft vertical separation from aeroplanes on the same route.

ACTF Position: The ACTF recommends that the CAA proposal to ICAO to improve existing SLOP by introducing offset allocation by flight level is given full support. **(Recommendation ACTF02)**

6.3 Advanced Strategic Offset Concept (ASOC)

ASOC aims to reduce the risk of collision due to increasing lateral navigation accuracy. This is only a few metres with GPS, so that in the event of any vertical error, there will be a high probability of an overlap and hence collision on any one- or two-way airway. This risk can be reduced by means of ‘micro offsets’ of less than one mile right of track which effectively restore the scatter present in traditional navigation and provide miss-distance. Although much, but by no means all of the traffic in the ICAO European region follows random routes, for which offsets offer no additional protection, considerable numbers of one- and two-way airways exist outside the region; this is where the majority of the risk resides. All FMS-equipped aircraft can fly offsets, but most are limited to offset values of whole miles; the modification required is simply to allow decimal values to be entered. Airbus and Boeing have indicated that they intend to introduce this minor change in new-build aircraft. At present some 20% of large commercial transport aircraft (the Boeing 737 fleet) are capable of micro offsets which means that some 40% of encounters could be protected immediately and at no cost, provided only that a simple change is made to the ICAO Rules of the Air.

ACTF Position: The work on developing the use of ASOC should continue. The CAA should support the work of the ICAO group involved and add some sense of urgency to it. **(Recommendation ACTF07)**

6.4 **Improved UK AIRPROX Reporting outside UK Airspace**

The CAA is unable to react effectively to the high number of airborne conflict incidents outside of UK airspace due to lack of information, in particular in taking appropriate action relating to the findings of an investigation report. There is a clear need to improve the quality and quantity of data received and recorded. Additional information would enhance analysis of the airborne conflict risk area outside UK airspace and enable the CAA to be better informed to make policy decisions or undertake Safety Improvement Projects.

ACTF Position: The CAA should:

i) review its MOR procedures to ensure it receives all investigation reports of AIRPROX outside of the UK, produced by foreign organisations, in a timely fashion;

ii) review its policy of closing MORs on receipt where investigations are conducted by foreign oganisations, to reinforce the message to UK operators to pass on any supplementary information to CAA;

iii) consider asking reporters to use the UK AIRPROX form to report an AIRPROX outside of the UK and expand the number of fields on the MOR database to include fields that are completed on AIRPROX forms but which are not currently recorded on the database. **(Recommendation ACTF03)**

This is felt consistent with the message from other task forces that the CAA, through the Safety Risk Management Process Project, should conduct a review of safety data collection, coding and analysis to best establish and monitor the key risks to UK civil aviation and to track the success of associated recommendations. This review would:

- establish an appropriate risk classification scheme for MORs;
- establish a multi-tiered structure of SPIs to monitor the key safety risks;
- identify alternative sources of safety data outside the scope of the MOR Scheme (e.g. FDM);
- propose mechanisms for data to be shared;
- propose a standardised set of measures, based on such data, for industry to monitor and report to the CAA.

7 Conclusions

7.1 The task force has reviewed work already completed in the area of airborne conflict. This review has closed all but three of the previous recommendations identified. The three outstanding recommendations have been developed further as ACTF Recommendations.

7.2 The task force has completed a systematic analysis of risks relating to airborne conflicts. This has identified that the greatest risk of airborne conflict exists outside the UK and that the most effective barrier in the resolution of conflicts is correctly following ACAS RAs, which supports the need for effective flight crew training.

7.3 The task force has identified three Tier 2 SPIs which the CAA is able to monitor using MORs. These SPIs measure airborne conflict risk in UK-controlled, UK uncontrolled and non-UK airspace. The effectiveness of recommendations, proposed by the task force and targeting specific areas of airborne conflict risk, can be indirectly monitored using the SPIs that measure the overall airborne conflict risk.

7.4 Further to these SPIs, Tier 3 SPIs could be developed which could be monitored at an operational level by industry.

7.5 Due to the very broad scope of airborne conflict and the existence of many groups currently undertaking activities associated with its prevention, the task force has found it a challenge to determine new strategies to contribute to current efforts to mitigate the risks. However, a number of initiatives have been identified to improve ACAS training, encourage revised SLOP and improve AIRPROX reporting outside of UK airspace. These are the subject of ACTF Recommendations.

7.6 The recommendations of the ACTF are listed in Appendix 11 and a CAA Task Force recommendation proforma is included for each. It is proposed that the ACTF will step back from the core work of implementing the recommendations, but will be available to provide an oversight of actions being taken to ensure that the work being carried out is meeting the intent of the recommendations.

Appendix 1 Airborne Conflict Task Force – Terms of Reference

Issue 1

16 October 2009

Introduction

The purpose, key tasks, composition and working arrangements of the task force are as described below. The task force is responsible for the revision and administration of these Terms of Reference for SRT approval.

Purpose

To work with relevant stakeholders and other associated working groups to review the causal factors and establish the key risks related to airborne conflict of UK commercial air transport / public transport aeroplanes, in particular AIRPROX risks outside of UK airspace, and to recommend strategies for monitoring and reducing these risks.

Key Tasks

- To review work already completed (e.g. recommendations made by the Mid-Air Collision Fishbone Working Group), or underway in the area of airborne conflict, both within the CAA and externally.
- To undertake a systematic analysis of risks relating to airborne conflict.
- To determine an SPI to monitor the risks.
- To develop new strategies for monitoring and reducing the key risks.

Composition

Membership will comprise a Chairman and Secretary (together forming the Secretariat), CAA experts and stakeholder representatives.

The Secretariat will be from Flight Operations.

CAA experts from the following areas will be represented:

- Air Traffic Standards
- Directorate of Airspace Policy
- Flight Operations
- Strategic Analysis

Stakeholder representatives from the following organisations will be represented:

- GAPAN
- UK AIRPROX Board
- NATS

Reporting

The task force reports to the SRT.

Meetings

Meetings are to be held under the Chatham House Rule.

The task force will meet regularly, but the use of teleconference facilities will be explored where practical. Ad-hoc working meetings will be required depending on the work programme and task allocation.

Deliverables

i) Recommendations for strategies for monitoring and reducing the risks related to airborne conflict presented in an EC Paper, endorsed by the SRT and Directorate of Airspace Policy management).

ii) Presentation of the work of the task force, its conclusions and recommendations at the CAA Safety Conference.

Records

Meeting agenda and notes will be recorded on ERMS.

Appendix 2 Airborne Conflict Task Force – Membership

Secretariat

John Benyon (Chairman)	Head Flight Operations Policy
Simon Williams (Secretary)	Flight Operations Policy

CAA Experts

Richard Hinchcliffe	Directorate of Airspace Policy
Phillip Tring	Air Traffic Standards
Greg Sims	Flight Operations
Chris Finnigan	Flight Operations
Matthew Lillywhite	Strategic Analysis

Stakeholder Representatives

Alex Fisher	GAPAN
David Balchin	UK AIRPROX Board
Karen Bolton	NATS

Correspondence Contact

Ken Thomson	Directorate of Aviation Regulation & Safety (DARS)

Appendix 3 Safety Performance Indicator (SPI) 2 Working Group Recommendations allocated to ACTF (Recommendations 8 to 12)

ACTF POSITIONS

Recommendation 8: The UK proposes to the European Commission the formation of an organisation, similar to the UK AIRPROX Board, to examine in detail airborne conflict events in European Airspace and to make recommendations.

Discussion: National AIRPROX agencies with their own detailed knowledge of national procedures and airspace issues are best placed to investigate and assess AIRPROX that occur in their own airspace. However, it is perceived that the investigation and the assessment of European AIRPROX are not conducted in a uniformly structured and cohesive manner and that the results of any investigations are not promptly or widely disseminated for the benefit of the whole aviation community. In the absence of a comprehensive report and assessment by the responsible national body into the circumstances of each AIRPROX, it is not feasible to accurately establish the cause of AIRPROX occurrences or the risk to UK-registered commercial air transport / public transport aeroplanes involved in such AIRPROX that occur outside the UK in European Airspace. Similarly, any lessons that might have been learned for the benefit of the UK aviation community are, most probably, being missed.

In some European Nations, AIRPROX are investigated by national air accident investigation agencies and, although the UK's Air Accident Investigation Branch has an obligation to investigate 'serious incidents' involving civilian aircraft, all AIRPROX occurring in UK airspace are still investigated and assessed by the independent UK AIRPROX Board, who release into the public domain comprehensive reports twice yearly. The voluntary 'open' reporting of AIRPROX by pilots and controllers to the UK AIRPROX Board has been a key element within, and a valuable contribution to, UK flight safety overall. However, it is not clear whether individual European nation states have joint civil/military AIRPROX boards similar to the UKAB model.

An open reporting environment is the bedrock of the UK integrated joint civil/military flight safety culture, enshrined in the Air Navigation Order and military regulations, where joint civilian and military reporting/assessment is considered intrinsic to the comprehensive assessment of AIRPROX. This 'just' flight safety reporting culture that the UK benefits from is also espoused by ICAO in *Annex 13 to the Convention on International Civil Aviation* (see Chapter 8). The ability of pilots and controllers alike to voluntarily submit AIRPROX reports to individual national AIRPROX boards without fear of retribution, and within a frank, open and honest AIRPROX reporting system, is considered to be a fundamental prerequisite.

Without consistent and coherent reporting and investigation of AIRPROX there can be no overarching review of all European AIRPROX. Whilst reports from national bodies might identify national concerns, trends that might affect the wider European aviation community cannot be established. Furthermore, with relatively small numbers of AIRPROX annually, the compilation of European-wide reports would increase the size of the data set available for analysis. A network of Europe-wide independent national AIRPROX organisations, preferably operating on the UK joint military/civilian UK AIRPROX Board model and contributing to a communal database, is the recommended model to ensure widespread promulgation of AIRPROX reports. The database could then be examined for specific trends across European Airspace for the benefit of the whole European aviation community and could potentially assist the progression of any Safety Recommendations made. Additionally, such a network could facilitate the gathering of pilots' reports, thereby assisting individual national AIRPROX organisations with more efficient gathering of investigative data.

The creation of a 'European AIRPROX Network' is manifestly a long-term aim. A logical first step and the natural precursor to further efforts towards the ultimate goal of European AIRPROX harmonisation would seem to be, therefore, a Europe-wide review of AIRPROX investigative and assessment organisations currently established within each nation state.

ACTF Position: It is recommended that the UK AIRPROX Board is requested to undertake a Europe-wide review of AIRPROX investigative and assessment organisations currently established by each nation state, to support a proposal to the European Commission for the formation of an organisation, similar to the UK AIRPROX Board, to examine in detail airborne conflict events in European airspace. **(Recommendation ACTF04)**

Recommendation 9: The CAA and MoD review the remit and resources of the UK AIRPROX Board to maximise its effectiveness.

Discussion: The objectives and methods of the UK AIRPROX Board have changed little since it was first formed. The UKAB's latest Draft Business Plan includes as an objective for 2010 a review of potential improvements to the AIRPROX system. In conjunction with all key stakeholders a report is to be produced for consideration by the CAA Chair and Chief of the Air Staff, RAF, MoD, with recommendations for improvements to the UK's AIRPROX system to better contribute to overall flight safety in the UK. It is considered that this meets the intention of the recommendation.

ACTF Position: Recommendation being progressed – awaits final report

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Recommendation 10: The UK engages with the European Commission, ICAO and other organisations with the aim of mandating the use of English at all busy international airports.

Discussion: There are challenges in pursuing this recommendation in establishing the relative benefits of use of native language in regional areas dominated by regional operation, against the universal use of a single language. ATSD continues to advocate the use of a single language at major airports in Europe. In collaboration with other areas of SRG, ATSD has produced a paper highlighting the risks of using more than one language and inviting EUROCONTROL to consider the development and introduction of an international agreement that English should be the only language used for ground-air communications at airports with significant levels of international CAT within the EUROCONTROL area. The paper is awaiting presentation to the EUROCONTROL Safety Regulation Commission. Additionally, Release 1.2 of the European Action Plan for the Prevention of Runway Incursions (EAPPRI) contains a recommendation that, where practicable, all communications associated with runway operations should be conducted in aviation English, in order to improve situational awareness. It is considered this meets the intention of the recommendation.

ACTF Position: Closed

Recommendation 11: The UK engages with stakeholders to make greater use of standard ICAO phraseology wherever possible.

Discussion: The UK policy is to specify ICAO-standard RTF phraseology except where there are safety concerns regarding the use of the ICAO phraseology in the UK environment. It is an area kept under review by the CAA and NATS. The CAA-sponsored Phraseology Working Group is a key forum for the development of such issues.

As part of the implementation of the UK/Ireland Functional Airspace Block (FAB), ATSD is working towards harmonising as far as possible the ICAO Differences filed by both States, and this has highlighted the number and nature of the UK Differences. The aim is to harmonise UK and Irish phraseology where possible, although there will be instances where the existing Differences may need to be retained for safety reasons.

ACTF Position: Closed

Recommendation 12a: The CAA should raise awareness of international hot spots where the mix of commercial air transport and general aviation results in a higher risk of airborne conflict.

Discussion: Whilst operators take an internally distributed view upon hot spots this information is not formally shared with other operators. Any proposal for such a formal sharing would need to be agreed with industry and the political considerations of such a process taken into account by the DfT.

Operators would not readily undertake to share ‘intelligence’ upon international hot spots, out of a concern for potential litigation. Whilst some form of forum in which such knowledge could be shared to potential good effect would be desirable, the commercial interest of operators possessing the intelligence would probably preclude ready agreement to such a proposal. Furthermore, any highlighting of AIRPROX hot spots in overseas Authorities would need careful consideration on the part of the DfT, which would take time to achieve, and thus the relatively realtime benefit of the information would likely be lost.

It is considered that, whilst the publishing of information indicating hot spots would undoubtedly be beneficial to flight safety, the practical and political ramifications of so doing would be unacceptably high both to the CAA and to operators.

ACTF Position: The CAA should submit the evidence of the significant number of airborne conflict events taking place outside of UK airspace and seek advice from the DfT on measures it would view as being politic and practical to raise the visibility of those particular areas outside of UK airspace where there is a high risk of airborne conflict. **(Recommendation ACTF05)**

Recommendation 12b: The CAA should encourage that more comprehensive information should be published in Aeronautical Information Publications (AIP), both in the UK and overseas, concerning data that provides planning information for crews for arrivals and departures (e.g. levels normally expected at waypoints).

Discussion: The standards for the form and content of the AIP are set at ICAO level, in *Annex 15* for the AIP and *Annex 4* for aeronautical charts. The international standard is used as the basis for a digital AIP format that has been developed in Europe and will soon be re-adopted by ICAO as an international standard for the digital AIP.

Commission Regulation (EU) 73/2010 lays down requirements on the quality of aeronautical data and aeronautical information for the Single European Sky (SES).

Studies have shown that international standards are not being met, and that the quality of aeronautical information is not sufficient to meet the requirements of the future ATM network.

This (digital AIP) project supports the CAA strategy towards meeting International standards (Chicago Convention Directions) and compliance with the European SES legislation. The objective of this project is to ensure UK compliance with EU Regulations.

The digital AIP will be directly embedded within the SESAR system-wide information management (SWIM) system as a layer contributing to collaborative decision making (CDM). The benefits are considered to be substantial, not only in terms of improved decisions, but also in unifying working methods across the whole European ATM network, with consequential improvements in efficiency.

The UK, along with the other States, populates the AIP in accordance with the ICAO standards. There may, in some instances, be minor national variations; however, these are slowly being ironed out as we move towards the digital AIP.

The boundary of each AIP is the territory of the State and protocols dictate that data for other States is not normally included. Some coordination between States to agree on FIR boundary crossing points is required and that, among other things, is often a difficult process.

States' providers would not insert new blocks of data into either the GEN, ENR or AD sections of the AIP purely after being encouraged by the CAA or their State Regulatory body. A proposal to include new data fields in the AIP would need to be developed and presented to ICAO; in Europe this is usually coordinated through the Aeronautical Information Team. The proposal would then be the subject of an ICAO State Letter for consultation, which is a protracted bureaucratic process.

ACTF Position: Closed

Recommendation 12c: The CAA should engage with EUROCONTROL to minimise or end the use of conditional clearances.

Discussion: NATS have significantly reduced the use of conditional clearances other than where operationally essential (LHR and LGW for example) and this appears to be revealing safety improvement. UK policy reflects ICAO on the use of conditional clearances, in that it does not inhibit them and allows well-trained professionals to exercise their judgement in the appropriate and timely use of them. NATS are viewing the use of conditional clearances more as an exception, i.e. as a practice to be reduced and only to be employed where operational benefit outweighs any potential risk. NATS have not yet made any proposal to update *CAP 493 Manual of Air Traffic Services Part 1* or to change ICAO policy. In terms of engaging with EUROCONTROL, a possible initial approach being considered is to raise the issue at the EUROCONTROL ATC Procedures Design Steering Group, attended by ATSD.

ACTF Position: Closed

Recommendation 12d: The CAA should engage with EASA to amend certification standards to include a requirement to ensure that automatic flight prevents a rate of climb/descent to an assigned level that would trigger an ACAS RA by aircraft cruising at the next available level.

Discussion: High rates of climb and descent, particularly in the last 1,000 ft before level off, cause a large proportion of current ACAS RAs – these are sometimes even called 'Nuisance RAs'. The resultant ACAS call out of 'Adjust Vertical Speed' still causes confusion amongst the pilot community and can lead to an incorrect response, which is one of the issues that will be hopefully resolved with ACAS software V7.1 which introduces the 'Level Off' command.

This subject has been discussed by the ICAO OPS Panel and the Surveillance and Conflict Resolution Systems Panel (SCRSP), now termed the Aeronautical Surveillance Panel (ASP), for a number of years and agreement was reached for both short- and long-term solutions:

In the short term, recommendations were made to amend both *Annex 6* and *PANS-OPS* to include instructions to pilots to moderate rates of climb and descent when approaching a cleared level, when the pilot is aware of another aircraft at or approaching an adjacent altitude or flight level. This material is now in *Annex 6 (4.4.10)* and *PANS-ATM (III-3-3-2)*. The CAA has published guidance to operators on rate of climb/descent in the form of *AIC Pink 92/2009* and information can also be found in *CAP 768*, Chapter 12, Section 6.4 Monitoring Progress in a Climb or Descent. This guidance has been included into operators' Operations Manuals and SOPs.

For the long term, whilst modification of existing FMS equipment logic to allow an automatic reduction in vertical rate when approaching an altitude is not considered viable, the problem is generally recognised and it should be taken into account when manufacturers develop the logic of new systems.

ACTF Position: Closed

Recommendation 12e: The CAA should engage with EASA to make the use of headsets a requirement on pilots and controllers when conducting their duties.

Discussion: It is considered that existing practices generally comply. Guidance and recommendations on the subject were reviewed and as a result FOI (A) Com No 67 was issued to instruct Flight Operations Inspectors to review Operations Manuals to ensure that operators have procedures in place to ensure that a listening watch is maintained at all times on the flight deck. There has been no trend observed of further incidents occasioned by a headset not being worn by a single pilot remaining on watch on the flight deck and therefore it is considered that there is insufficient evidence to warrant engaging with EASA.

ACTF Position: Closed

Appendix 4 Mid-Air Collision Fishbone Working Group – Recommendations allocated to ACTF

ACTF POSITIONS

Study of RA Events: Carry out a study of ACAS RA events, to include determining the proportion of RAs that are deemed to be unwanted or unnecessary and evaluating the effects of proposed new operational procedures, many of which are driven by the need to increase capacity, on the triggering rate of ACAS RAs.

Discussion: ACAS events are reportable under the Mandatory Occurrence Reporting Scheme (MORS), as set out in *CAP 382*. Using MOR data as a source of RAs, there is no evidence to suggest that unwanted/unnecessary RAs are a frequent occurrence. However, such an issue is unlikely to be highlighted in MORs as flight crew do not necessarily know if an RA is genuine or not.

A number of European States are in the process of developing realtime downlink of ACAS RA information from aircraft to air traffic control rooms. However, there is concern that such a move would provide little safety benefit and would likely provide significant distraction to an already busy controller. That said, facilitating the downlink of this information for subsequent analysis after the event, to enable subsequent safety analysis and to inform future safety strategy, was supported.

Following an analysis of MOR data, there is no evidence to suggest that TCAS RAs are being produced outside of their intended specified area of performance. However, unintended RAs may be reduced in future by the introduction of the operational and technological solutions outlined in SPI 2 Working Group Recommendation 12d.

ACTF Position: Closed

Dispatch Philosophy for ACAS: Recommend that EASA reviews the philosophy in allowing operators to dispatch with inoperative ACAS equipment for up to ten days.

Discussion: The only EASA National Authority known to impose a rectification interval of less than 10 days is Germany. However, the Japanese Civil Aviation Bureau requires serviceable ACAS equipment for Commercial Air Transport. Information upon the philosophy of these national requirements would permit the CAA to make a recommendation to the ASI ACAS Working Group regarding the possibility of consideration of more stringent regulation of the serviceability of ACAS equipment for UK operators.

It is considered that further advice is required in order to take an informed view upon the rationale exercised by other National Authorities in the decision-making process in respect of Minimum Equipment List (MEL) alleviations of ACAS equipment.

ACTF Position: It is recommended that the Airspace & Safety Initiative (ASI) Airborne Collision Avoidance Systems (ACAS) Working Group be tasked to source information on MEL alleviation decisions, for example by the German and Japanese Authorities, in order that a subsequent recommendation be considered for submission to EASA to review the Rectification Intervals that are applied to ACAS equipments. **(Recommendation ACTF06)**

Feasibility Study on Radar Data Monitoring: Conduct a feasibility study on the potential benefits to ATM of Radar Data Monitoring, using experience gained through aircraft Flight Data Monitoring (FDM).

Discussion: Radio Telephony and ATC radar recordings are already used to assist in the investigation of ATC incidents. ACAS responses can also be simulated. The use of FDM data could provide further information about activities within the cockpit, which have been causal to the event. However, extreme care would have to be taken in the use of this data to ensure that the safety and reporting culture was not damaged or inhibited through the development of ATC versus flight crew ‘blame’ cultures. Current ATM investigation processes appear to work well with the current, albeit limited, use of FDM data, providing additional data when required without impacting on ATC and Flight Deck reporting cultures. It is considered that this meets the intention of the recommendation.

ACTF Position: Closed

Explore Opportunities to Improve Air/Ground Safety Nets: Explore opportunities to improve the performance of both air- and ground-based safety nets e.g. STCA.

Discussion: Enhanced Short Term Conflict Alert (ESTCA), in operation at LTC (since May 2008) and Prestwick, currently uses Mode-S Selected Altitude information in two ways to help provide additional warning time for potential conflicts. Firstly, if an aircraft is in level flight and the selected altitude is different to the aircraft's current level, then this is taken to indicate an imminent departure from level. As such ESTCA provides the aircraft with an assumed rate of climb (as the vertical tracker often takes a few sweeps to detect that an aircraft has left its level, so this is intended to provide additional warning time in these situations). Secondly, the Linear Prediction filter now predicts that an aircraft will level off at its selected altitude. However, to stop suppressing alerts between aircraft with high rates of climb and descent the 'Linear Prediction Alternative Hypothesis' filter was added to predict conflicts without using SFL information. It should be noted that the SFL used is the SFL derived from the Main Control Panel and not the Flight Management System or the 'Target Altitude' which is the next value from each of these sources. Developments in ATC systems, such as SESAR, will see ATC ground-based safety nets enhanced further as an integral part of the design process. It is considered that this development meets the intention of the recommendation.

ACTF Position: Closed

Literature Review of "See and Avoid" Guidance: Commission a literature review of the existing guidance on the use of "see and avoid", with the objectives of:

- establishing performance limits (and hence a degree of 'creditworthiness');
- establishing how to optimise performance;
- generating guidance on flight crew training to maximise "see and avoid" performance, including airspace awareness.

Discussion: *FODCOM 27/09 Collision Avoidance – Use of and Limitations associated with the See and Avoid Principle*, issued August 2009.

ACTF Position: Closed

Obtain Better Estimates of Utilisation Outside of Controlled Airspace: Commission a study to obtain better estimates of aircraft utilisation outside of controlled airspace.

Discussion: Inside controlled airspace, since it is a known environment, accurate statistics for the level of utilisation are always available and consequently analysis of usage can be conducted to gauge the impact of changes. Outside controlled airspace, however, many users are free to operate without any form of pre-authorisation, control or notification (subject to appropriate licensing and regulation, etc.). Two projects have recently been (independently) initiated;

- NATS – 'Touchstone' analysis
- CAA/MoD – QinetiQ Model

'Touchstone' is based on the secondary surveillance picture only (transponder/SSR equipped and 'on'), at the fringes of NATS 'controlled' airspace (Class A-D) in the adjoining background (Class F & G) airspace within the Scottish FIR. This project forms one element of a NATS multi-faceted approach, addressing CAS infringements in an attempt to understand traffic patterns/behaviour close to (but outside) the boundaries, both vertical and horizontal, of CAS.

The QinetiQ Study is an attempt to gain a 'picture' of all types of background airspace users. QinetiQ considers that, through the capture of relevant data and effective modelling of airspace user behavioural patterns, representative statistics can be derived to generate a reliable quantification of activity outside of CAS, and that such quantification would be of significant value to the ASI community. The first stage Pilot Study commenced May 2010.

Modelling will characterise the behavioural activity of different airspace users and stakeholder groups under different circumstances in such a way that the characterisation could be applied to similar circumstances that prevail at other geographical locations (characterised according to length of sortie, operating area and altitudes, weather limitations, time of day, and so on). From this, representative patterns and trends of aerial activity can be derived that could be used in subsequent analyses. As more data becomes available, the model itself can be improved to derive ever more reliable information.

Common factors such as prevailing weather, day of the week, and local factors such as geographical location and proximity to CAS will modulate the underlying behavioural characteristics of each group. The model will not allow the user to determine exactly how many aircraft of each classification would be airborne and operating in any area at any specific time. The results would show an expected traffic density for the conditions entered into the model.

ACTF Position: Closed

Review Guidance on Human-Machine Interface Issues for Ground Equipment: Review the guidance contained in *CAP 670 Air Traffic Services Safety Requirements* as to whether best practice regarding human-machine interface (HMI) issues employed for flight deck controls and displays could be applied to ground equipment.

Discussion: A search for **HMI** or **Human Machine Interface** in *CAP 670* produces references in three main sections of the document:

1. Abbreviations.

2. COM01 Minimum performance specification for recording equipment.

3. RAD 07 Ergonomic Aspects for Radar Display System.

Of these, RAD07 has the most detailed entry and explains a suitable method of specifying and testing the adequacy of the HMI. It applies to all displays used for Air Traffic Services radar data at aerodromes and subject to approval under Air Navigation Order Article 124. It also provides a link to useful supporting ICAO documents, including *DOC 9758 Human Factors Guidelines for Air Traffic Management Systems*. There are other recommendations elsewhere in the document that impact on HMI. For example, in the section on the Air Traffic Monitor it states "colour is not to be used for information coding". There is also the requirement that as from 21 June 2007 Service Providers must have an approved Safety Management System. Enquiries have identified that more extensive guidance was contained within *CAP 670* but this was removed as it was felt that ANSPs should have greater ownership of the HMI issues associated with their equipment rather than simply relying on meeting the guidance in *CAP 670*. However, guidance material on subjects such as the use of TFTs has been produced in other documents.

ACTF Position: Closed

Safety Alerts on CAA Website: Place headline safety alerts in a single easy-to-access place on the CAA website.

Discussion: A request has been submitted for the CAA website to have a direct link to the Safety Critical Information page. It has been proposed that the Publications box at the top of the Popular Information list on the right-hand side of the CAA homepage is amended to read: "**Publications** View Publications online and subscribe to free email notifications. Includes **Safety Critical Information**." The CAA website is currently subject to review and update and it is understood that the intention of this proposal will be considered during this review.

ACTF Position: Closed

Appendix 5 Other Working Groups and Committees

TOPIC	GROUP	PURPOSE
Level Busts	UK Level Bust WG	To monitor the occurrence rate, understand the causes behind events and develop strategies to counter the occurrence of Level Busts
Collision Warning	Airspace & Safety Initiative (ASI) Airborne Collision Avoidance Systems (ACAS) WG	To monitor ACAS developments and issues arising from the use of ACAS and non-ACAS Collision Warning Systems (CWS) by all categories of pilot in all classes of aircraft.
Airspace Infringements	Airspace Infringement Working Group (AIWG)	To monitor the occurrence rate, understand the causes behind events and develop strategies to counter the occurrence of Airspace Infringements
Outside Controlled Airspace	Air Traffic Services Outside Controlled Airspace (ATSOCAS)	Initiative to review ATSOCAS.
Business Aviation Safety	Business Aviation Safety Partnership	To monitor the occurrence of Safety-Significant Events involving Business Aviation and to work closely with industry to incrementally raise safety within the sector
AIRPROX	UK AIRPROX Board	To enhance flight safety in the UK, in particular in respect of lessons to be learned and applied from AIRPROX occurrences reported within UK airspace.

Appendix 6 Worldwide Fatal Accidents – Mid-Air Collisions 1997-2008

Analysed by the Accident Analysis Group (AAG)

Date	Aircraft Type	Location	Accident Description
25/03/1997	Bombardier (Shorts) SC.7 Cessna 207	(near) Nunapitchuk	The aircraft was destroyed when it went out of control and crashed after coming into collision with a Cessna 207. The Cessna also crashed. The accident happened in daylight (1123L) and in fine, clear weather. The Skyvan had departed from runway 36 at N
30/07/1998	Raytheon 1900 Cessna 177	(near) Vannes	The aircraft was destroyed when it went out of control and crashed into the waters of the Baie de Quiberon after coming into collision with a Cessna 177 (F-GAJE) of Francis Gillibert. The Cessna also crashed. The collision happened at a height of about 2,
01/07/2002	Boeing 757 Tupolev TU154M	(near) Uberlingen	A Bashkirian Airlines Tupolev TU154M (RA-85816) and a DHL Boeing 757-200PF (A9C-DHL) came into collision near Uberlingen. As the result of the collision both aircraft went out of control and crashed killing all onboard. The TU154 was carrying 57 passeng
29/09/2006	Boeing 737 (NG) Embraer Legacy 600	(near) Peixote Azevedo	While en route between Manaus and Brasilia and in normal cruise flight, a GOL Linhas Aereas Boeing 737-800 (PR-GTD) came into collision with an Excelaire LLC Embraer Legacy 600 business jet (N600XL), which was en route.

Appendix 7 UK High-Severity (MOR Grade A + B) Airborne Conflict Events 2005-2008

Analysed by The High Risk Events Analysis Team (THREAT)

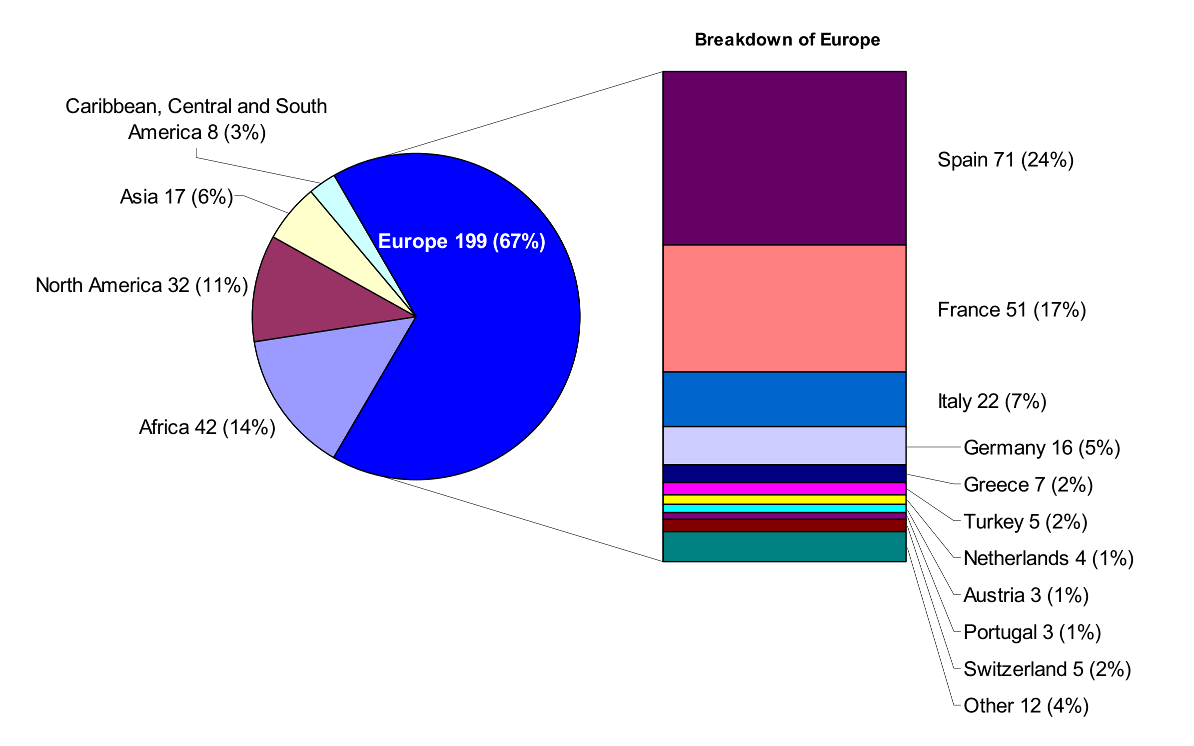
Date	Aircraft Type	Location	Airborne Conflict Description
27/01/2005	Military, EMB 145	EBOTO, United Kingdom	UK AIRPROX 8/2005 / AAIB Serious Incident - EMB145 and military jet between EBOTO and SIVDA at FL210.
02/03/2005	SA332 Super Puma, SA332 Super Puma	Oil Rig, North Sea	UK AIRPROX 23/2005 - Two AS332Ls, 28nm ENE of Aberdeen at 2000ft. Loss of standard separation.
15/08/2005	Piper PA46 Malibu, B737	Liverpool, United Kingdom	UK AIRPROX 139/2005 - B737 and a PA46 5nm East of Liverpool Airport at 1600ft. Conflict alert and SMF activated.
24/02/2006	SA365 Dauphin, Military	Benbecula, United Kingdom	UK AIRPROX 24/2006 - SA365 and a military jet, 50nm East of Benbecula at 600ft. Severe avoiding action taken by the pilot of the SA365.
05/04/2006	Paraglider, Jetstream 41	Southampton, United Kingdom	UK AIRPROX 38/2006 - JS41 and a paraglider, 6nm NNE of Southampton at 3000ft.
17/07/2006	Jetstream 41, Military	ALASO, United Kingdom	UK AIRPROX 107/2006 - JS41 and military a/c 10nms North of ALASO at FL165. During JS41 avoiding action a cabin crew member suffered minor injuries, but was able to continue working.
31/07/2007	DHC8, Microlight	Norwich, United Kingdom	UK AIRPROX 107/2007 - DHC8 and a microlight, 10.6nm Northwest of Norwich at 2000ft.
21/09/2008	Microlight, B757	Isle Of Wight, United Kingdom	UK AIRPROX 139/2008 - B757 and an unknown microlight at FL180. Possible infringement of Class C airspace by the unknown microlight.
25/01/2005	Bell 212, ATR 42	Nouakchott, Mauritania	Foreign AIRPROX - Bell 212 and an ATR42. Subject to investigation by the Mauritanian authority.
25/05/2005	A321, Katana Dv20	Malaga, Spain	FOREIGN AIRPROX - A321 and Katana at 800-900ft following A321 departure from Malaga. A321 received TCAS TA. No traffic info passed by ATC.
17/06/2005	B747, Unknown	Kolkata FIR	FOREIGN AIRPROX in the Kolkata FIR between B747 and airliner at approximately 2330N and 9300E. Both a/c appear to have been cleared at FL360. Reporter's a/c received a TCAS TA.
16/10/2005	A320, A320	HANKO, Turkey	Foreign AIRPROX-Two A320 a/c over HANKO at FL320. Both a/c received and reacted to TCAS RAs. Subject to investigation by the Turkish authorities.
21/10/2005	B767, Unknown	Sanford, US	Foreign AIRPROX - B767 and light twin a/c. Subject to investigation by the US authority.
30/01/2006	B767, B757	CORSI, Italy	Foreign AIRPROX - B767 and B757. Subject to investigation by the Italian authority.
02/02/2006	A340, B747	LISMU RIZO, Russia	Foreign AIRPROX - A340 and a B747-400 at 11,100 metres/FL360. TCAS RA received and actioned. Subject to investigation by the Russian authorities.
10/09/2006	Unknown, A319	Dortmund, Germany	A319 on approach received a TCAS RA descent against a VFR a/c that had been instructed to turn downwind. However, the a/c turned base. A319 continued on approach and landed uneventfully.
10/10/2006	B777, BE90 King Air	Jacksonville, United States	Four cabin attendants injured when a/c entered sudden descent in response to TCAS RA. PAN declared on arrival.
03/05/2007	B767, Unknown	Sanford, United States	FOREIGN AIRPROX - B767 and unknown a/c. Subject to investigation by the US Authorities. TCAS RA climb received and actioned.
05/07/2007	B767, Unknown	Sanford, United States	B767 crew observed another a/c on TCAS below and indicating climbing. A/c continued to close until B767 received TCAS RA to climb. B767 followed TCAS instruction.
21/08/2007	A319, BE33 Debonair / Bon*	Alicante, Spain	Foreign AIRPROX - A319 and a Beech F33A at 1000ft on departure from Alicante. Subject to investigation by the Spanish authorities.
27/01/2008	B767, Unknown	Philadelphia, United States	At night, B767 was in late stages of finals on R/W27R when ATC cleared an a/c to land on intersecting R/W35. B767 believed a/c would land behind, but a/c landed on R/W35 600m ahead of B767.
21/04/2008	A340, B757	LIE VOR, Latvia	Foreign AIRPROX - A340 and B757. Subject to investigation by the Latvian Authority. AAIB Serious Incident.
12/05/2008	A319, Glider	Dortmund, Germany	FOREIGN AIRPROX - A319 and a glider near Dortmund at FL60. Crew had been given general traffic info on gliders and ATIS was warning of the gliders. Subject to investigation by the German Authority.
29/05/2008	A330, Unknown	OMN VOR, United States	Foreign AIRPROX - A330 descending to 6000ft received a TCAS TA on opposite direction traffic. A330 became visual with traffic and identified it as a Cessna single. Subject to US investigation.
05/06/2008	B757, Unknown	ORBIS, Spain	FOREIGN AIRPROX - B757 and unknown a/c during descent into Madrid. Pilot alleges poor ATC controlling. TCAS RA followed.
25/07/2008	B747, Balloon Met	Barcelona, Spain	Foreign AIRPROX - B747 and weather balloon at FL350. Subject to investigation by the French authority.

Appendix 8 Expanded Analysis of Airborne Conflict Events (MOR Grade A–D)

Analysed by the Airborne Conflict Task Force (ACTF)

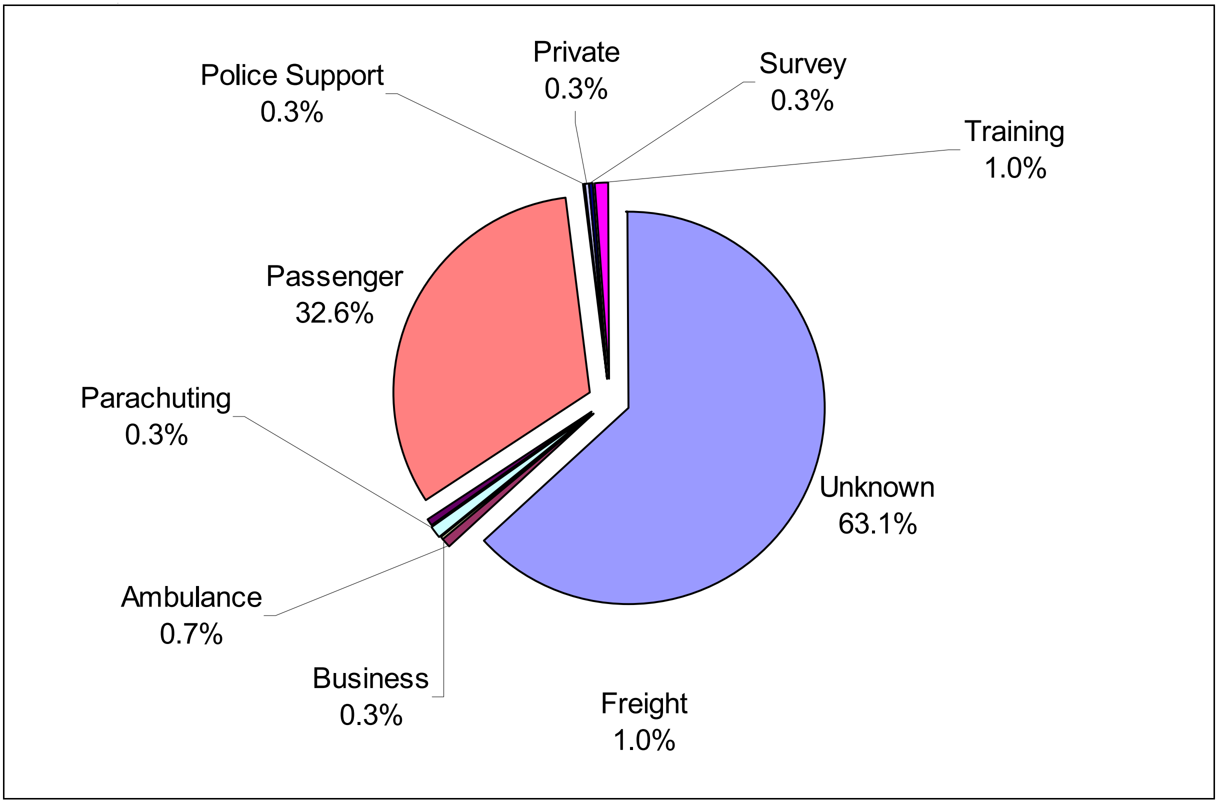
Data Criteria:

- Events during the period 2005-2009;
- UK-Registered/Operated Aeroplanes;
- Maximum Take-off Weight Authorised > 5,700 kg;
- UK Commercial Air Transport (CAT);
- *Outside* of UK airspace.



Phase of Flight of Airborne Conflict Events

		ICAO Region					
		Africa	Asia	Caribbean, Central and South America	Europe	North America	Total
Phase of Flight	Approach/Descent	10 (24%)	3 (18%)	4 (50%)	103 (52%)	19 (59%)	139 (47%)
	Initial Climb / Climb	10 (24%)	4 (24%)	3 (38%)	45 (23%)	7 (22%)	69 (23%)
	Cruise	21 (50%)	10 (59%)	0 (0%)	44 (22%)	4 (13%)	79 (27%)
	Hold	1 (2%)	0 (0%)	1 (13%)	3 (2%)	0 (0%)	5 (2%)
	Landing	0 (0%)	0 (0%)	0 (0%)	2 (1%)	0 (0%)	2 (1%)
	Take Off	0 (0%)	0 (0%)	0 (0%)	1 (1%)	2 (6%)	3 (1%)
	Unknown	0 (0%)	0 (0%)	0 (0%)	1 (1%)	0 (0%)	1 (0%)
	Total	42	17	8	199	32	298



Appendix 9 Barrier Model applied to Airborne Conflict Events

ATC Procedures

- Resolution by timely and effective controller action.
- Resolution by controller, prompted by technology, e.g. Short-Term Conflict Alert.

Flightdeck Procedures

- Resolution by flight crew following visual sighting.
- Resolution by flight crew due to increased situational awareness provided by ACAS (excluding resolution advisories).
- Resolution by flight crew due to increased situational awareness via use of radio.

ACAS – Resolution Advisory

- Resolution by flight crew prompted by ACAS RA.

Providence

- All other barriers failed, aircraft missed each other by providence.

Unknown

- Not enough information to determine which barrier resolved conflict.

Appendix 10 Hierarchy of Safety Performance Indicators (SPIs)

Tier 1 SPIs

These will present high-level safety indicators for the operational groups listed below. An example would be the current SPI 2 for high-severity UK commercial air transport aeroplanes. The operational groups for each Tier 1 SPI should be:

- Commercial Air Transport Aeroplanes
- General Aviation
- Public Transport Helicopters
- Business Jets.

Tier 2 SPIs

Tier 2 SPIs will supplement Tier 1 SPIs and will address more specific safety issues for which the CAA has sufficient data. Tier 2 SPIs would relate to subjects being reviewed by the task forces as follows:

- Runway Excursions
- Ground Handling
- Runway Incursions
- Loss of Control
- Airborne Conflict
- Controlled Flight Into Terrain
- Airborne Fire.

However, it might be appropriate for more Tier 2 SPIs to be produced, for example, on Level Busts as a subset of Airborne Conflict.

All Tier 2 SPIs should be produced by the CAA.

Tier 3 SPIs

With the increasing use of SMS, the CAA will not have access to all safety or operational data. In these cases, the CAA may advise service providers/operators on the Tier 3 SPIs that they should be monitoring. For example, under FDM programmes, the CAA may advise operators to monitor certain FDM parameters to indicate unstable approaches. The CAA will not have access to the raw data to produce the SPI, but may be involved in assessing the SPI 'information' provided by airlines.

It is hard to define all Tier 3 SPIs at this stage. However, each task force may be able to suggest Tier 3 SPIs based on their detailed assessment of the issues investigated.

Appendix 11 Airborne Conflict Task Force Recommendations

ACTF Reference	Recommendation	Deliverable	Timescale from start
ACTF01	EUROCONTROL monitor the quality of pilot responses to ACAS events and publish their findings regularly. CAA Flight Operations should review the EUROCONTROL data and appropriate follow-up action should be undertaken to ensure appropriate and timely crew responses to ACAS events across industry. CAA Flight Crew Standards should sample the quality of Simulator ACAS training and establish the range of capabilities of devices to simulate realistic ACAS event scenarios and ensure that operators are aware of the potential of each simulator in this regard. CAA Flight Crew Standards should clarify where the definitive source of guidance for ACAS training now lies given that it is believed that TGL 11 is no longer extant. Similarly efforts should be made to amend ICAO *Doc 8168* to cover these issues adequately.	Enhanced ACAS training within industry leading to reduction in erroneous or tardy crew responses to ACAS events as indicated by EUROCONTROL statistics	1 year
ACTF02	The CAA proposal to ICAO to improve existing SLOP by introducing Offset Allocation by Flight Level is given full support.	State Letter encouraged and supported	1 year
ACTF03	The CAA should: (i) Review its MOR procedures to ensure it receives all investigation reports of AIRPROX outside the UK, produced by foreign organisations, in a timely fashion. (ii) Review its policy of closing MORs on receipt where investigations are conducted by foreign oganisations to reinforce the message to UK operators to pass on any supplementary information to CAA. (iii) Consider asking reporters to use the UK AIRPROX form to report an AIRPROX outside of the UK and expand the number of fields on the MOR database to include fields currently not recorded but completed on AIRPROX forms.	Report	6 months
ACTF04	The CAA requests UKAB to undertake a Europe-wide review of AIRPROX investigative and assessment organisations currently established by each nation state to support a proposal to the European Commission supporting the formation of an organisation, similar to the UK AIRPROX Board, to examine in detail airborne conflict events in European Airspace.	Report	6 months

ACTF05	The CAA should submit the evidence of the significant number of airborne conflict events taking place outside of UK airspace and seek advice from the DfT on measures it would view as being politic and practical to raise the visibility of those particular areas outside of UK airspace where there is a high risk of airborne conflict.	Position Paper	3 months
ACTF06	The Airspace & Safety Initiative (ASI) Airborne Collision Avoidance Systems (ACAS) Working Group be tasked to source information on MEL alleviation decisions in order that a subsequent recommendation be considered for submission to EASA to review the Rectification Intervals that are applied to ACAS equipments.	Position Paper	6 months
ACTF07	The CAA should support the work of the ICAO group developing the use of ASOC and add some sense of urgency to it.	State Letter encouraged and supported	1 year

Task Force:

Airborne Conflict

Recommendation Reference:

ACTF01

Recommendation Title:

CAA to review Airborne Collision Avoidance System (ACAS) Training to assess how representative current simulators are and clarify the definitive source of guidance for ACAS training.

Recommendation Scope: *(tick all that apply)*

Regulatory Change ☒ Guidance Material ☒ Training ☒ Further Study/Research ☒

Procedural Change ☐ Technology ☐ Other

Addressee (e.g. CAA):	If CAA, then Proposed Recommendation Sponsor (CAA Business Area):
CAA	Licensing & Training Standards

Justification:

Risk(s) to be Mitigated (focus on safety risk, business risk optional):

Incorrect pilot response to ACAS Resolution Advisories (RAs).

Risk(s) of not Implementing:

Mid-air collision resulting from incorrect use of ACAS.

Benefits:

Enhancement of final barrier to mid-air collision, other than providence.

Supporting Data:

N/A

Task Force:

Airborne Conflict

Recommendation Reference:

ACTF02

Recommendation Title:

CAA proposal to ICAO to improve existing Strategic Lateral Offset Procedures (SLOP) is fully supported

Recommendation Scope: *(tick all that apply)*

Regulatory Change ☒ Guidance Material ☐ Training ☐ Further Study/Research ☐

Procedural Change ☒ Technology ☐ Other

Addressee (e.g. CAA):	If CAA, then Proposed Recommendation Sponsor (CAA Business Area):
CAA	Flight Operations

Justification:

Risk(s) to be Mitigated (focus on safety risk, business risk optional):

Over the past five years, the use of SLOP had progressively reduced the lateral overlap probability in NAT RVSM airspace and in doing so has contributed to a lessening in the Vertical Collision Risk. However, as implemented on a voluntary basis, SLOP has not had the desired effect of spreading the traffic evenly across the three available lateral positions. The CAA proposal is to mandate offsets based on flight level, which would ensure not only lateral separation from adjoining flight levels but also a 3,000 ft vertical separation from aeroplanes on the same route.

Risk(s) of not Implementing:

A failure to reduce risk of collision or serious vortex encounter on oceanic track systems as originally envisaged when SLOP was introduced.

Benefits:

Enhanced Vertical Collision Risk reduction and improvement in pilots' situational awareness in oceanic and remote airspace.

Supporting Data:

CAA Paper presented to NAT Ops/Air Meeting in Miami, December 8–10 2009.

Task Force:

Airborne Conflict

Recommendation Reference:

ACTF03

Recommendation Title:

CAA should ensure it receives all investigation reports of AIRPROX outside the UK. The CAA's policy of closing on receipt MORs where investigations are conducted by foreign oganisations should also be reviewed to reinforce the message to UK operators to pass on any supplementary information to CAA. The CAA should also consider asking reporters to use the UK AIRPROX form to report an AIRPROX outside of the UK and expanding the number of fields on the MOR database to include fields currently not recorded but completed on AIRPROX forms.

Recommendation Scope: *(tick all that apply)*

Regulatory Change ☐ Guidance Material ☒ Training ☐ Further Study/Research ☐

Procedural Change ☒ Technology ☐ Other

Addressee (e.g. CAA):	If CAA, then Proposed Recommendation Sponsor (CAA Business Area):
CAA	Group Safety Services

Justification:

Risk(s) to be Mitigated (focus on safety risk, business risk optional):

Inability of CAA to react effectively to the high number of Airborne Conflict incidents outside of UK airspace due to lack of information.

Risk(s) of not Implementing:

CAA is unable to take appropriate action relating to the findings of an investigation report or conduct analysis of events utilising all available information.

Benefits:

Additional information will enhance analysis of the Airborne Conflict risk area outside UK airspace and enable CAA to be better informed to make policy decisions or undertake Safety Improvement Projects. Information on AIRPROX events provided by operators would be more consistently reported and therfore more easily interpreted.

Supporting Data:

N/A

Task Force:

Airborne Conflict

Recommendation Reference:

ACTF04

Recommendation Title:

The CAA requests the UK AIRPROX Board to undertake a Europe-wide review of AIRPROX investigative and assessment organisations currently established by each nation state, to support a proposal to the European Commission for the formation of an organisation to examine in detail airborne conflict events in European Airspace.

Recommendation Scope: *(tick all that apply)*

Regulatory Change ☐ Guidance Material ☐ Training ☐ Further Study/Research ☒

Procedural Change ☐ Technology ☐ Other

Addressee (e.g. CAA):	If CAA, then Proposed Recommendation Sponsor (CAA Business Area):
CAA	Group Safety Services

Justification:

Risk(s) to be Mitigated (focus on safety risk, business risk optional):

Inability of CAA to react effectively to the high number of Airborne Conflict incidents outside of UK airspace due to lack of information.

Risk(s) of not Implementing:

Airborne Conflict events in European Airspace are not properly investigated and CAA is unable to take appropriate action relating to the findings of an investigation report.

Benefits:

More accurate understanding of airborne conflict events in European Airspace.

Supporting Data:

N/A

Task Force:

Airborne Conflict

Recommendation Reference:

ACTF05

Recommendation Title:

The CAA should submit the evidence of the significant number of airborne conflict events taking place outside of UK airspace and seek advice from the DfT on measures it would view as being politic and practical to raise the visibility of those particular areas outside of UK airspace where there is a high risk of airborne conflict.

Recommendation Scope: *(tick all that apply)*

Regulatory Change ☐ Guidance Material ☒ Training ☐ Further Study/Research ☒

Procedural Change ☐ Technology ☐ Other

Addressee (e.g. CAA):	If CAA, then Proposed Recommendation Sponsor (CAA Business Area):
CAA	Flight Operations

Justification:

Risk(s) to be Mitigated (focus on safety risk, business risk optional):

High probability of Airborne Conflict in certain areas outside of UK airspace.

Risk(s) of not Implementing:

Mid-air collision.

Benefits:

Reduced probability of airborne conflict.

Supporting Data:

N/A

Task Force:

Airborne Conflict

Recommendation Reference:

ACTF06

Recommendation Title:

The Airspace & Safety Initiative (ASI) Airborne Collision Avoidance Systems (ACAS) Working Group be tasked to source information on MEL alleviation decisions in order that a subsequent recommendation be considered for submission to EASA to review the Rectification Intervals that are applied to ACAS equipments.

Recommendation Scope: *(tick all that apply)*

Regulatory Change	☒	Guidance Material	☒	Training	☐	Further Study/Research ☒
Procedural Change	☐	Technology	☐	Other		

Addressee (e.g. CAA):	If CAA, then Proposed Recommendation Sponsor (CAA Business Area):
CAA	Directorate of Airspace Policy

Justification:

Risk(s) to be Mitigated (focus on safety risk, business risk optional):

Mid-air collision.

Risk(s) of not Implementing:

Mid-air collision that could have been avoided with ACAS.

Benefits:

Enhanced coverage of ACAS as a barrier to resolve conflicts.

Supporting Data:

N/A

Task Force:

Airborne Conflict

Recommendation Reference:

ACTF07

Recommendation Title:

The CAA should support the work of the ICAO group developing the use of Advanced Strategic Offset Concept (ASOC) and add some sense of urgency to it.

Recommendation Scope: *(tick all that apply)*

Regulatory Change ☒ Guidance Material ☐ Training ☐ Further Study/Research ☐

Procedural Change ☒ Technology ☒ Other

Addressee (e.g. CAA):	If CAA, then Proposed Recommendation Sponsor (CAA Business Area):
CAA	Flight Operations

Justification:

Risk(s) to be Mitigated (focus on safety risk, business risk optional):

Collision due to increasing lateral navigation accuracy. With the accuracy of GPS, now typically only a few metres, in the event of any vertical error there will be a high probability of an overlap and hence collision on any one- or two-way airway. This can be reduced by means of ‘micro offsets’ of less than one mile right of track which effectively restore the scatter present in traditional navigation and provide miss distance. Such offsets should be invisible to ATC. Offsets are ineffective, though benign, on random routes.

Risk(s) of not Implementing:

Collision following any vertical error on a one- or two-way airway (e.g. Brazil 2005).

Benefits:

Reduced collision risk.

Supporting Data:

An analysis has been carried out by the Maths Study Group on behalf of the ICAO SASP.

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Report 6 Ground Handling Operations Safety Team Task Force

Executive Summary

The Ground Handling Operations Safety Team (GHOST) was created in 2007 as a result of EC *Paper 39/07*; in which the need was identified to form a group to address findings and recommendations from the Ground Handling Fishbone Working Group. Five subgroups, each chaired by SRG staff, have since been created to pursue the different strands of work.

Currently the CAA has no direct remit to regulate ground handling activities, with the exception of the specialist area of Dangerous Goods, so the purpose of GHOST has been to influence and share best practices across industry.

In 2009, the 'Significant Seven' task forces were created to address some of the biggest risks to commercial aviation in the UK. As GHOST has operated successfully for a number of years and is now a mature working group, it was judged best not to change the format or objective of the group, but to incorporate the task force deliverables into its current work streams.

The Terms of Reference (ToR) for 2010 contain the tasks and deliverables for 2010 (see Appendix 1).

For a list of participating organisations see Appendix 2.

1 Recommendations

Recommendation 1: The CAA should continue to investigate whether enhanced or direct oversight of UK Ground Handling activities is necessary.

i) Currently the CAA has no direct remit to regulate ground handling activities, with the exception of the specialist area of Dangerous Goods. Oversight of other ground handling activities occurs indirectly via the SRG auditing of AOC holders' and aerodrome licence holders' oversight of contractors or third parties.

ii) The Health and Safety Executive, with whom the SRG has a Memorandum of Understanding, publishes regulations, guidance material and information which has an impact on some of the work carried out during the ground handling process. However, the objective is to ensure the safety of employees and other persons who may be affected, not the safety of aircraft or safe flight.

iii) No minimum standards exist for the majority of ground handling activities; guidance is available although this is not mandatory. For example, the IATA Safety Audit for Ground Operations (ISAGO) is built upon agreed industry standards and recommended practices; however, participation is voluntary and there is an associated charge.

iv) There is an established international framework for ground handling which includes a standard IATA contract between the airline and ground service provider, local procedures, industry QMS and (in some cases) ISAGO auditing. However, the level of incidents still occurring indicates that this is not functioning to full effect. IATA is now also working on an IATA Ground Operations Manual (IGOM), and the CAA and European Commercial Aviation Safety Team (ECAST) are engaged in this work.

v) An initial review of regulatory oversight and audit methodology was carried out by GHOST in 2009; however, the group recommended a more in-depth review of UK regulatory oversight of ground handling activities. This review will need to consider the interfaces with the established framework.

vi) A three-part survey is currently being undertaken to review the effectiveness of the oversight of AOC holders' quality assurance of Ground Handling Service Providers, including:

- internal records check of CAA oversight to date;
- as part of the routine oversight of AOC holders in 2010, a Specific Objective Check (SOC) examining AOC holders' quality assurance of their Ground Handling Service provision;
- a questionnaire to a wide range of ground handling organisations to gauge their experience of airline or other oversight audits.

vii) It is further recommended that a similar three-part survey be undertaken to review the level of oversight that aerodromes have of ground handling service provision.

viii) The findings of these reviews, together with recommendations about the continued effectiveness of the present arrangements, will determine the need for any improvements in regulatory oversight and/or audit methodology either by the CAA or by EASA (see Recommendation 6). This review will need to consider likely fees and charges.

Recommendation 2: The CAA should promote increased standardisation of ground handling procedures.

i) AOC holders produce ground operations procedures; however, most ramp and dispatch personnel handle numerous operators' aircraft and are thus in the un-enviable position of having to comply with a variety of procedures in any one day. Consequently there is great potential for confusion and human error.

ii) It is recommended therefore that the CAA should encourage airlines to move towards adopting common procedures/SOPs for ground handling. Much work has already been done in this area (i.e. by IATA and ECAST) and it is not intended that new procedures are developed.

iii) Pending a decision whether or not the CAA should increase its regulation and oversight, GHOST develops, promulgates and promotes guidance material. Areas already under development include:

- a DVD raising awareness of loading errors;
- guidance/requirements on airside driver training;
- guidance on stand design and apron lighting;
- guidance on reporting of ground handling MORs;
- a FODCOM has already been published encouraging adoption of the IATA ISAGO standards or equivalent and should be kept under review.

Where appropriate, Safety Performance Indicators (SPIs) have been designed to measure the impact of some of this guidance.

iv) It is further recommended that GHOST should continue to co-ordinate, facilitate, disseminate and enhance the 'best practice' completed via its work streams.

v) It is proposed to create a GHOST webpage on the CAA website to contain:
- GHOST Terms of Reference, Minutes and a list of Members;
- agreed guidance material;
- links to other relevant websites such as ECAST, IATA and IAHA to share the work being conducted by others (see Recommendation 5).

Recommendation 3: The CAA should adopt a coherent, coordinated approach to the management of ground handling issues.

i) Given the small amount of SRG formal oversight, internal SRG coordination of ground handling issues is not consistent. This can lead to conflicting or uncoordinated messages being given to industry.

ii) It is recommended that SRG develop a robust process that ensures that consistent messages are given, and that GHOST material is promoted during contact with industry.

Recommendation 4: The CAA should encourage AOC holders and aerodrome licence holders to initiate ground handling service safety campaigns.

See also Recommendation 8.

Recommendation 5: The CAA should remain engaged in international efforts aimed at improving safety in ground handling activities and encouraging the adoption of best practice.

i) Much work has been and is being undertaken to develop strategies to mitigate the safety risks from ground handling and ground support activities in the UK and elsewhere; clearly the scope of the activity is worldwide. Although specific UK procedures and guidance aimed at UK-based ground handlers, airports and AOC holders will help to mitigate the risk to UK-registered and other aircraft whilst in the UK, in order to be completely effective the guidance and best practice must be adopted internationally.

ii) Therefore, it is recommended that the CAA continues its involvement in ECAST, IATA, and other industry bodies with the aim of encouraging international adoption of best practice and where possible, providing examples of this best practice.

Recommendation 6: The CAA should encourage EASA to consider whether common European rules for ground handling are desirable.

i) It is clear that the most effective action to reduce risks from ground handling activities will be taken on an international basis. The outcome from the reviews in Recommendation 1 will inform the CAA's view as to whether further regulatory oversight or actions are desired.

ii) EASA Implementing Rules for Flight Operations take effect in 2012 and those for Aerodromes will take effect in 2014. Thus, it is logical for EASA to address any safety concerns in ground handling in the long term.

iii) Ground handling does not appear in the EASA rule making 2010–2013 work plan, and it is understood that at the present time EASA may not have sufficient resources to take on this task. However, dependent upon the conclusion of the review in Recommendation 1, and given the amount of damage and costs that result from ground handling incidents, EASA may wish to consider whether common European rules in this area are desirable.

Recommendation 7: The CAA should explore the human factors aspects of ground handling safety.

i) The vast majority of ground handling related incidents and events have human failings as causal factors. The immediate and obvious processes within the ground handling framework are in place: contracts are drawn up, procedures exist, equipment is designed for and is generally fit for purpose, staff are trained and should be competent, and a certain level of auditing takes place. Yet, mistakes still happen.

ii) Therefore, it is recommended that the CAA should explore the human factors aspects of ground handling safety in depth as many other areas within the industry have experienced step-changes in safety improvements after adoption of human factors principles.

Recommendation 8: The CAA should promote better use of data within the industry.

i) Much discussion has been had on the fact that the CAA MOR database does not hold the relevant information to monitor precursor events. This is especially true for ground handing, as reporting in the ground handling community is low. However, most AOC holders have a wealth of data relating to incidents to their aircraft and thus they are best placed to monitor lower-level events using their own data.

ii) It is recommended that the CAA, through the Safety Risk Management Process Project, conducts a review of safety data collection, coding and analysis to best establish and monitor the key risks to UK civil aviation and to track the success of associated recommendations. This review should:

- establish an appropriate risk classification scheme for MORs;
- establish a multi-tiered structure of SPIs to monitor the key safety risks (high-risk SPIs at the top and drilling down into lower-level precursors);
- identify alternative sources of safety data outside the scope of the MOR Scheme (e.g. FDM) to fill gaps in our safety knowledge;
- propose mechanisms for such data to be shared, with appropriate safeguards;
- propose a standardised set of measures, based on such data, for industry to monitor and report to the CAA (these measures would contribute the lowest-level precursors to the key safety risks).

2 Implementation

GHOST is a long-standing cross-industry group that has objectives beyond the terms of reference of the task force work. Therefore, it is suggested that GHOST ToRs are amended to include monitoring of accepted Recommendations and SPIs.

3 Safety Performance Indicators

1. *Number of Ramp MORs at UK aerodromes or involving UK AOCs:*

   a) *Number of ramp MORs grouped by the process during which they occurred;*

   b) *Number of ramp occurrences grouped by (potential) outcome*.

   To monitor the general trend in ground handling MORs, these incidents will be further broken down by the ground handling process during which they occurred and by potential outcome.

   One of the deliverables for GHOST in 2010 was to increase the awareness of the ground handling community of the MOR Scheme and which ground handling incidents must be reported. Based on previous experience from awareness campaigns, it may be expected that this will result in an **increase** in reported MORs for ground handling. Therefore, any trends in the above SPIs must be seen in this light. To determine whether any increase or decrease is significant, the ratio of high-severity to high- and low-severity MORs could be compared for ground handling related occurrences with that for all occurrence types across the entire database.

2. *Number of loading errors reported by UK AOC holders at UK aerodromes.*

   This is to determine the success of the loading error DVD in raising awareness of the importance of accurate aircraft loading. However, in the short term the additional awareness raised by the DVD may cause an increase in MORs due to increased awareness of the issue – this is to be welcomed.

3. *Number of runway incursions by vehicles at UK aerodromes.*

   This will determine whether the proposed airside driver training and permit scheme, incorporating more stringent requirements for vehicle operators on the movement area and runways, is successful. This SPI will also be useful to the Runway Incursion Steering Group.

4. *Number of collisions between vehicles and parked aircraft at UK aerodromes.*

   This will determine whether the guidance on stand design and lighting (expected in 2011), as well as the driver training guidance and permit scheme mentioned above, have been successful in reducing damage caused to aircraft during the turnaround process.

5. *Number of (near-)collisions between vehicles and aircraft during taxi, pushback or whilst under tow at UK aerodromes.*

   This figure will measure whether the new driver training programme has been successful in increasing drivers' awareness and professionalism on the movement area (as opposed to during the turnaround process as measured in SPI 4).

   NOTE: It may be possible to determine SPIs 3–5 specifically for those aerodromes that have fully implemented the new driver training scheme, and to compare them with aerodromes that have not yet implemented the scheme.

Appendix 1 GHOST – Terms of Reference (review due January 2011)

1 Aim

To work with the UK aviation industry, organisations and groups worldwide to develop strategies to mitigate the safety risks from ground handling and ground support activities in the UK and elsewhere.

2 Objectives

To review existing strategies and, where appropriate, to make recommendations to the Safety Risks Team (SRT) for the implementation of new or revised strategies and safety interventions to address specific ground handling hazards.

3 Team Composition

The team will comprise representatives from divisions within the SRG and also invited representatives from UK industry including Ground Handling Organisations (GHO), Airlines, Airport Operators and the HSE. This membership will be reviewed at each ToR review.

From time to time, other bodies will be invited to contribute to the initiative, e.g. Human Factors Experts.

The team will be chaired by Aerodrome Standards.

4 Scope and Methodology

GHOST will meet quarterly, at a venue decided by the Chairman to be convenient to the agenda items to be undertaken at that meeting. Meeting notes will record the subject matter discussed, agreements reached or decisions taken, and actions. An actions log will be maintained.

The team members will contribute to the entire group direction; however, the use of subgroups will optimise the strengths and expertise of GHOST members to achieve the objective. To that end, the following work streams have been identified:

- Database Development, Data Recovery and Analysis
- Loading Errors
- Review of *CAP 642*
- Regulatory Oversight and Audit Methodology.

These work streams will function independently, but each will report on their activities through a Focal Point (FP) to the main body. The FP will be responsible for reporting to the Chairman on the deliverables of their work stream at each quarterly meeting.

Subgroup meetings will be held at least once between each GHOST meeting, with ongoing liaison as required. Meeting notes will be taken and distributed to the subgroup members and to the GHOST Chairman.

5 Tasks and Deliverables

a) **Key Tasks**

i) Co-ordinate the work streams within GHOST by formulating an action plan to present outputs with timescales.

ii) Collaborate with all bodies having ground handling (GH) interests, ensuring clarity of purpose without duplication of effort, with the intention of harmonising GH procedures and policies.

iii) Act as a forum to discuss ground safety issues, with a view to arriving at a common understanding of 'best practice'.

iv) Promote 'Safest Optimum Practice' GH procedures and safety initiatives to as wide an audience as necessary in the interests of reducing incidents.

v) Actively enhance the awareness of airside safety and publicise GH issues.

vi) Act as a coordination point through which organisations and groups can disseminate GH information.

vii) Influence international organisations and regulatory bodies through active participation in safety, to ensure the best interests of ramp safety are represented and developed.

b) **Deliverables**

i) Provide each SRT meeting following a GHOST meeting with updates from work streams, and where appropriate with recommendations.

6 Subgroup Tasks and Deliverables

6.1 GHOST Data Subgroup – Focal Point: Rowan Christou

a) **Purpose**

To use the MOR and Ascend databases to provide regular updates to GHOST on key statistics and serious incidents or accidents. To examine how data available to GHOST might be improved, either through better MOR reporting or alternative means of reporting.

b) **Key Tasks**

i) An analysis report using MORS and Ascend will be produced for each full GHOST meeting, or on a quarterly basis (whichever is the most frequent).

ii) A synopsis of the monthly GH MORs will be distributed to interested GHOST members.

iii) Brief each GHOST meeting on the most significant occurrences since the last meeting.

iv) Identify means of improving the information reported to MORS or develop an alternative means of reporting should it be required.

c) **Deliverables and Timescales**

i) Provide statistical data to the quarterly GHOST meetings or other subgroups as requested by them.

ii) Develop an appropriate GH SPI.

iii) Explore means of raising the profile of an open reporting system in conjunction with other subgroups' publicity campaigns, and make appropriate recommendations to GHOST by 2nd quarter 2010.

6.2 **GHOST Loading Error Subgroup – Focal Point: Jason Sandever**

a) **Purpose**

The purpose of the Loading Error subgroup is to review loading error information to ascertain failures, either singularly or through the identification of trends. Also, to raise the awareness of the impact of loading errors and the potential effects which result from these errors.

b) **Key Tasks**

i) Review loading error incidents, including air safety reports (ASRs) / ground safety reports (GSRs), to identify root causes and possible trends.

ii) Identify the top-five issues as shown by the incidents and identify work streams to address the root causes of these issues.

iii) Raise awareness of safe aircraft loading.

c) **Deliverables and Timescales**

i) Highlight incident causal factors, including trends, and report with any recommendations at the GHOST quarterly meeting.

ii) Complete production of loading error education material for promulgation to GHOs, by the end of 2nd quarter 2010. Draft material to be submitted to GHOST and thence the SRT for acceptance before final production and publication.

iii) Using MOR data and through the sharing of information, explore the robustness of load control functions in order to establish whether there is a need for further development of standards.

iv) Identify best practice 'Gross Error Checks' for promulgation and adoption by industry.

v) Identify best practice methods for completing 'Last Minute Changes' to load sheets, for promulgation and adoption by industry.

6.3 **GHOST CAP 642 Review Subgroup – Focal Point: Tony Heap**

a) **Purpose**

To review the current information in *CAP 642* and other documents and provide revised guidance to industry on Airside Safety Management.

b) **Key Tasks**

i) Consult with industry on the implementation of the National Driving Permit Scheme.

ii) Identify best practice to achieve benchmark standards for apron operations where applicable.

iii) Review and make recommendations for the revision of aircraft stand design requirements including visual aids and apron lighting requirements.

iv) Produce a revised *CAP 642*.

v) Incorporate into *CAP 642* and other documents any information from GHOST sources which will improve airside safety.

c) **Deliverables and Timescales**

i) Produce a draft Regulatory Impact Assessment for discussion by GHOST by 1st quarter 2010.

ii) Produce an implementation plan for the new National Airside Driving Scheme, endorsed by the AOA and GHOST, by 3rd quarter 2010.

iii) Recommend aircraft ramp design improvements to GHOST by 2nd quarter 2011.

iv) Recommend material for the apron lighting requirements by 2nd quarter 2011.

v) Produce a draft of *CAP 642* for consultation.

6.4 **Regulatory Oversight and Audit Methodology Subgroup – Focal Point: Nick Landauer**

a) **Purpose**

To consider issues concerning the present and future regulatory oversight of ground handling and ground handling organisations. To examine current ground handling audit methodology employed by both operators and other organisations, to establish and disseminate best practice.

b) **Key Tasks**

i) Conduct research into the effectiveness of the oversight of third parties to UK AOC holders.

ii) Produce a paper to GHOST outlining the key findings of the above research and recommending an appropriate course of action.

c) **Deliverables and Timescales**

i) CAA Flight Operations to conduct a Specific Objective Check (SOC) to cover:

- what any CAA oversight of UK AOC holders has shown thus far with respect to third parties by 2nd quarter 2010;
- as part of the quality check of AOC holders, a review of their oversight of third parties by 4th quarter 2010;
- as best as is possible from the Ground Handlers' point of view, how effective the oversight is that they get from their customers, by 4th quarter 2010.

ii) Produce a paper to GHOST outlining key findings of the above research and recommending an appropriate course of action by 1st Quarter 2011.

Appendix 2 List of Participating Organisations in GHOST (as at May 2010)

CAA
Flight Operations
Survey
Aerodrome Standards
Safety Data
Strategic Analysis

Airlines
Astraeus
BBA Aviation
bmi

British Airways
DHL
easyJet
Flybe
MK Airlines
MyTravel
Virgin Atlantic

Ground Handling Organisations
ASIG
Aviance
Menzies
Servisair
Swissport
Plane Handling

Airports
BAA
Gatwick Airport
Luton Airport
Manchester Airport
East Midlands Airport

Other Organisations
Health & Safety Executive
UKFSC
Human Engineering
DCA International

Report 7 Airborne and Post-Crash Fire Task Force

Executive Summary

An action from the Safety Conference held in January 2009 was to form joint CAA-industry working groups, to identify why global fatal accidents and UK high-risk events were increasing and what could be done to remedy the situation. Seven task forces were formed to address the top-seven contributing factors; Airborne and Post-Crash Fire was one such task force.

So far, the task force has reviewed the incidents behind why airborne and post-crash fires features in the top-seven factors. In addition to the analysis of this data, research has been carried out on what work has been done previously, both internally and externally, in the field of in-flight and post-crash fires.

The work carried out has shown that the majority of fires occur in the galley, passenger and toilet areas. However, the occurrence of a hidden fire is considered to have the greatest potential for an uncontrolled event.

Based on the analysis, research and discussion with industry, the task force has proposed 12 recommendations or Safety Improvement Projects (SIPs) for consideration. Safety Performance Indicators (SPIs) have been drafted.

The Terms of Reference for the task force are outlined in this paper, along with the proposed methodology for it.

This report provides a summary of these issues and a progress update.

1 Introduction

The Airborne and Post-Crash Fire task force was formed as a result of a review of global fatal accidents and UK high-severity events. The figure below shows the trend of the high-severity occurrence rate for large public transport aircraft.

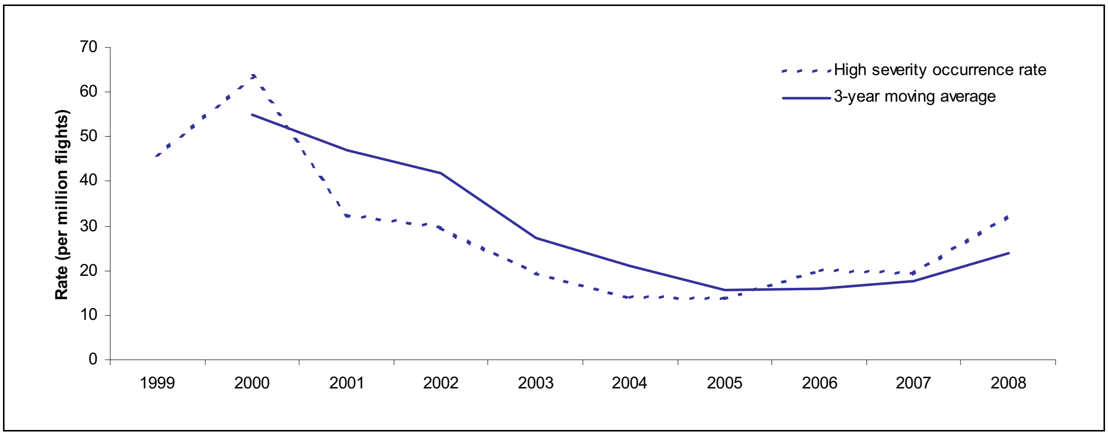

Figure 1 High-Severity Occurrence Rate for Large Public Transport Aeroplanes

The CAA Safety Plan sets out the safety actions to be taken, which should address when implemented, the safety improvements that meet the targets and achieve safety objectives. The formation of the Airborne and Post-Crash Fire task force is one of those actions described in the Safety Plan and its recommendations will be the start of the undertaking to try and improve the safety trend.

The task force, consisting of specialists from the CAA and representatives from industry, was formed in June 2009 with a remit to review the causal factors and make recommendations on areas where safety improvements may be made. The task forces' Terms of Reference are shown in Appendix 1.

The purpose of this report is to highlight contributions that the CAA may make, through research, guidance or persuasion of others, to conduct research to reduce the risks of aircraft fires. Fire is an omnipresent threat to life, exacerbated in aircraft by the large quantities of highly flammable fuel, ignition sources and limited possibilities of escape.

2 Task Force Approach

In order for the task force to determine possible recommendations or safety initiatives to address the drivers behind the statistics shown in the Global Fatal Accident and the UK High-Severity Event bar charts (see Appendix 8) which were attributed to fire, it was necessary to review the incidents concerned.

Recommendations in this report are based on this analytical review coupled with reviews of research being undertaken and of outstanding recommendations from previous studies. In addition, the task force listened to the experiences and concerns of industry to ensure that its output would be valued both by the CAA and industry alike.

3 Work Undertaken

3.1 Analysis of SRG worldwide fatal accident data where accidents were attributed to fires for the period from 1 January 1998 to 31 December 2008

The task force analysed the causal factors relating to the worldwide fatal accidents. Appendix 3 shows a brief summary of causal factors concerning the 37 accidents attributed to fire. From this analysis seven aircraft accidents appear to have been primarily caused by fire or fire was a significant contributing factor. Most accidents were associated with take-off or landing incidents that resulted in a post-crash fire. Implementation of the findings from the Runway Excursion Task Force may contribute to a reduction in the number of post-crash fire accidents.

As a summary and précis of the five most serious accidents where fire was considered to be the primary cause, or significant contributing factor:

- A Swiss Boeing (MD11) aircraft suffered a fire in the ceiling area aft of the cockpit which was most likely caused by local arcing coupled with Metallized Polyethylene Terephthalate (MPET) type cover material on insulation blankets, which then spread to other flammable materials. The probable source of the arcing was a power supply cable to an In-Flight Entertainment (IFE) network, but this could not be determined conclusively.
- A Fairchild aircraft had a dragging brake prior to take-off and then following retraction of the gear, a hydraulic leak was ignited by the heat of the brakes. The crew were unaware of the fire, until it affected the hydraulic lines and left engine. The wing broke off due to structural failure caused by the fire while the aircraft was still in flight.
- A Boeing aircraft on the ramp in Thailand exploded due to suspected fuel tank ignition with only residual fuel in the tank.
- During take-off, a Concorde ran over debris that resulted in a burst tyre and ruptured wing fuel tank. Leaking fuel was then ignited and no. 1 and 2 engines surged. The aircraft became airborne but crashed shortly afterwards.

- Three Antonov aircraft crashed, each of which appeared to have developed engine fires, but there was insufficient data to see if fire was the primary cause.

3.2 **Post-crash fire analysis – implications for aerodromes**

A review of the worldwide fatal accidents where post-accident fires occurred revealed that over 65% of accidents required robust emergency planning and response arrangements both on and off the aerodrome. In particular, the immediate vicinity of an aerodrome should receive an assessment of its terrain and topography, and arrangements for a suitable emergency response should be in place to assist escaping passengers, and to carry out fire-fighting and rescue any trapped survivors.

The UK and Europe have well developed civil protection arrangements that ensure local emergency management includes planning for such events and that there is consistency and collaboration between the aerodrome and local emergency responders. *CAP 168* sets out the emergency planning requirements for UK-licensed aerodromes (Appendix 7 gives more information on aerodrome planning). The CAA's oversight of licensed aerodromes has focused on emergency planning since the introduction of the Civil Contingencies Act 2004.

Work continues in the UK to enhance guidance in assessing environs in areas adjacent to approach and departure routes up to 1,000 m from the runways.

However, the CAA is less clear about the compliance of international airfields to the ICAO recommendations on runway clear areas.

From the review of the worldwide fatal accident database it was noted that runway excursions can result in a post-crash fire, and therefore this concern has been passed on to the Runway Excursion Task Force for their consideration. Operators may like to consider assessing airfields using their SMS, so as to understand the hazards and risks associated with a particular airfield.

3.3 **Summary of (Grade A or B) UK-reportable occurrences including fire for the period from 1 January 1999 to 31 December 2008**

The task force considered MORs graded A or B for UK reportable accidents and serious incidents involving UK public transport aircraft or UK aerodromes. Appendix 4 shows a summary of these occurrences and Figure 2 shows the type of fire involved.

There were a total of 27 events including four fatal accidents that were not caused by fire, but all had post-crash fires. Two occurred within the bounds of the aerodrome: a Learjet where the pilot appeared to have lost control of the aircraft on a single engine approach; the second, a Bombardier CL600 that appeared to have a wing stall on take-off due to ice. The third aircraft stalled on approach due to incorrect loading outside of the centre-of-gravity schedule, and the fourth aircraft crashed after take-off following spurious attitude director indicator (ADI) display, causing the aircraft to roll into the ground.

Three events related to brake fires after landing or rejected take-off (RTO), all of which were extinguished by the Aerodrome Fire Services (AFS).

There were three engine failures in which fires were controlled as required by the following of crew procedures; all the remaining engine failures were controlled through following operating procedures.

An ex-military aircraft had a main landing gear (MLG) that failed to extend causing the aircraft to land on an under-wing fuel tank, which broke away with a flash fire; the AFS extinguished the fire.

The in-flight incident with possibly most significance to the task force related to a B737, where a wiring loom chaffed and arced against a braided steel water supply hose in the ceiling just aft of the cockpit, causing smoke and burning. Hidden fires like this have the greatest potential to escalate into an uncontrollable event. In this case the crew were hampered by difficulties in communications with the cabin crew and locating the appropriate checklist on the index page of the quick reference handbook (QRH).

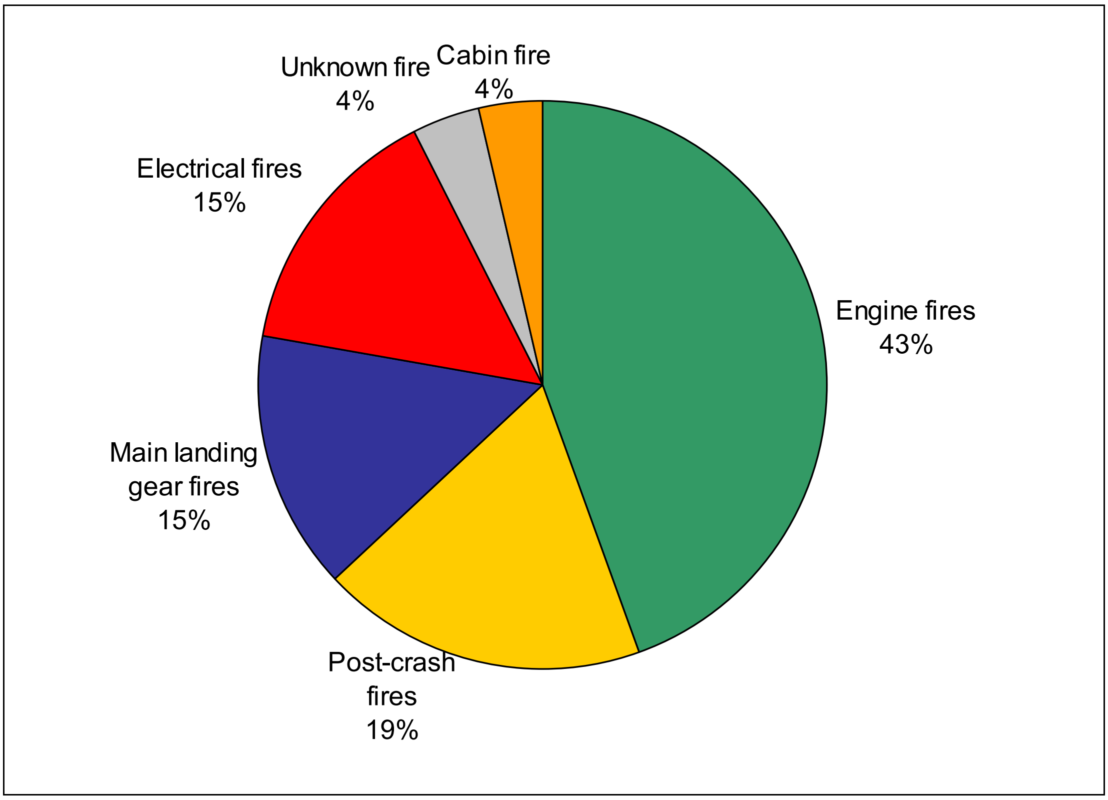

Figure 2 UK grade A and B MORs

3.4 **Analysis of the MOR data available on fire and smoke events that have occurred over the last ten years for aircraft >5700 kg**

The MOR database was searched for occurrences fulfilling the following criteria:

- 1 January 1999 to 31 December 2008;
- aircraft above 5,700 kg MTWA;
- UK-registered or operated aircraft, or UK-licensed aerodromes; and
- occurrences with coding such as fire, fire warnings, smoke/fumes, smoke warning, burnt, chaffed, (in terms of electrical wiring), APU fire/failure, engine fire/overheat.

In this way, all occurrences falling within the CAA's scope of regulation, either through airworthiness, operations or aerodromes would be retrieved.

The MOR database coding is structured such that some fire risks are grouped with other types of event. This is because the database is designed to cover a wide range of occurrences and because in some cases, either the detection methods or the outcomes are the same. For example, it is often difficult to differentiate between smoke or fumes; or as another example, if an APU catches fire or fails, the result is the loss of an APU in a potentially hazardous manner.

As the coding structure is not ideal for analysing fire occurrences, each occurrence was analysed in detail and divided into categories that could be reviewed by the task force. A diagram of the analysis is shown below.

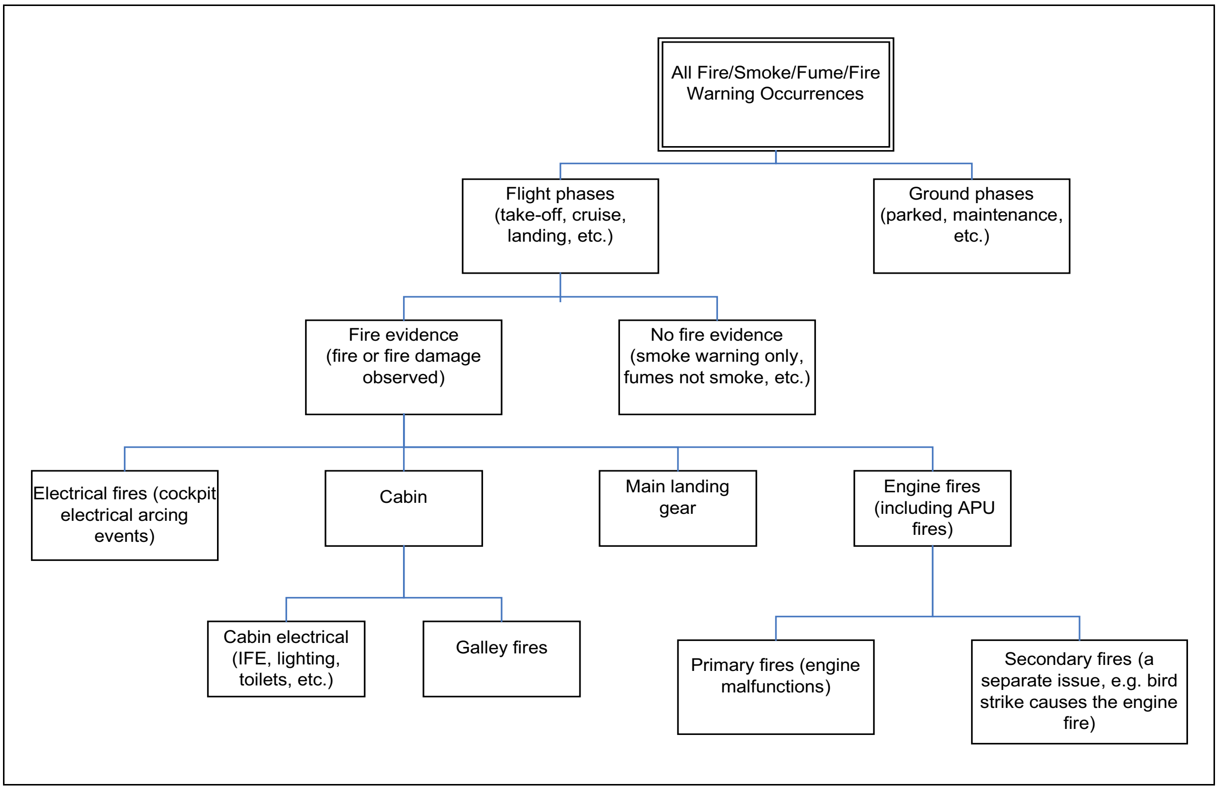

Figure 3 Diagram of UK MOR Analysis

Whilst not all the data has been analysed, the analysis has been prioritised to examine actual in-flight fire events first. These events can be split into four main areas: electrical, landing gear, engine and galley. Specialists in each particular field were used to review the data to see if any trends could be spotted, supported by other members of the task force.

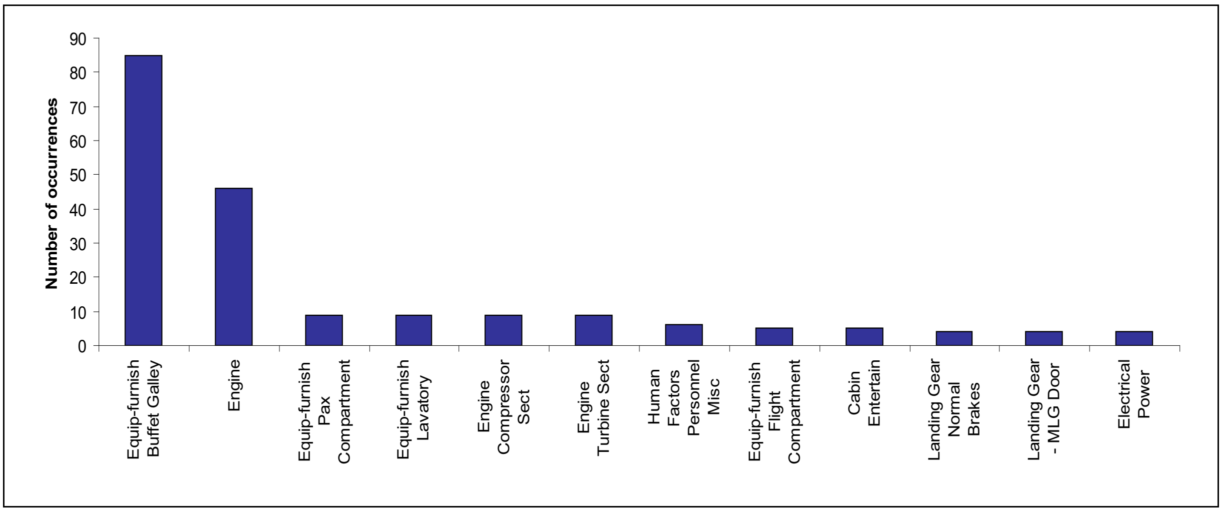

Figure 4 UK Fire Occurrences – Top 10 ATA Chapters

3.4.1 **Engine Data**

Engine fires are associated with many of the engine-related MORs and can be caused by numerous events. Most of the events are contained engine failures and as such, the task force considered these type of events to be managed in accordance with crews' operating procedures/QRH. Typical engine events included bird strikes, surges, high pressure and low-pressure turbine failures, compressor failures, false warnings, and bleed failures. In addition there were a few cases of ice-mat failures on the engine intakes. An engine specialist reviewed all the engine fire events, and followed up on three which gave cause for concern, but further review of the MORs and supporting data satisfied the engineer that appropriate work had been carried out to address these issues.

In review of the work done the task force considers engine failure / fire events to be manageable events by the following of crew operating procedures. Engine failure rates and reliability analysis is carried out by operators, manufactures and the certification specialists. The task force will aim to remove these events from the SPIs to be developed but retain data on uncontained engine failures that may have wider implications.

3.4.2 **Cabin Data**

Reported cabin fire events are almost all related to one of two sources:

- Galleys

Galley fire/smoke events are almost all associated with ovens. Oven fires are often caused by the ignition of foreign objects in the oven itself. This is often the packaging of food articles which should have been removed before heating, but sometimes the food itself. These events are associated with smoke, which can spread to passenger compartments and sometimes the flight deck. The appearance of the flaming object in the oven can cause further concern. However, in all these events the amount of burning material is small and provided it remains in the oven, forms no hazard to the aircraft. The fire is usually extinguished with a halon extinguisher, if deemed necessary. The other main source of oven internal fire is accumulated grease in the oven; this usually produces smoke. Oven malfunction is sometimes reported, causing some degree of overheat and smoke. These events result in removal of the offending oven but there is usually no report on the malfunction. It would appear that while there is a demand for hot meals to be served on the aircraft, the ovens will inevitably, from time to time, produce excess smoke and sometimes burn unintended objects. While it is accepted that operator's procedures should ensure that ovens are cleaned and operated correctly, occasions may occur when this ceases to be effective. Operators should ensure that appropriate training is provided to all personnel involved with the cleaning, loading and operation of ovens, and that such procedures are subject to a robust oversight program. New products and/or packaging should be assessed as to their suitability for heating in the ovens installed on an operator's aircraft, before being introduced.

- Toilets

Toilet fire/smoke events are invariably due to passengers illegally smoking in the lavatory compartment and inappropriate disposal of the cigarette. However, there have been several occurrences of inappropriate storage of paper products adjacent to either hot fluorescent ballast units or the hot water heaters. Ensuring that these materials are stored appropriately, or by preventing their storage in the locality, will help mitigate some of these avoidable events.

3.4.3 **Electrical Data**

From an electrical perspective the review showed that the main contributors were IFE and associated wiring, cabin lighting, galleys and windshield heating systems.

a) IFE

From a review of the IFE-related occurrences it was noted that some were attributed to maintenance, e.g. inappropriate cleaning of connectors, water ingress and faulty components. Refer to Appendix 5 for guidance material available to designers, operators and continued airworthiness organisations.

b) Cabin Lights/Signs

Many of these failures were attributed to wiring and faulty ballast units. The wiring aspects will be addressed by the new electrical wiring interconnection system (EWIS) requirements (see Recent Initiatives below) and occurrences should reduce. Ballast units do fail from time to time however, and their installation could be improved (e.g. terminal covers) to prevent contamination from condensation.

c) Galleys

The galley-related events were generally attributable to equipment failures. The requirements of *JAR/CS25.1365(b)* are intended to minimise the risk of galley appliances causing overheat or fire.

d) Windshield Heat Systems

There were a number of fires related to windshield heat systems. These systems carry high currents and can therefore dissipate a large amount of heat in the connectors and wiring, as a result of bad connections or high resistances in the windshield's heating laminate. These occurrences should reduce as a result of the introduction of the EWIS regulations (see Recent Initiatives below).

e) Recent Initiatives

Recently EASA and the FAA have implemented the new EWIS regulation. This regulation requires that TC holders (e.g. Boeing, Airbus) develop Instructions for Continued Airworthiness (ICA) for aircraft over 3,402 kg by 10 December 2009, and holders of STCs applied for after 1 January 2009 have to submit their ICA to EASA/FAA by 7 June 2010. The ICA take the form of zonal inspections and assess each zone that is identified as containing wiring. Therefore, by virtue of the tasks identified, chafed wiring and burnt connections (e.g. windshield heat) should be found, thus reducing the probabilities of occurrence.

EASA has introduced the requirement via *Part 21A-16*, and *AMC 20-21*. The FAA has introduced it via *FAR 26*, *AC25-26* and *AC 25-27*.

3.4.4 **Data Analysis of Smoke/Fume Events between 1998 and 2008**

This was a significant activity as there were in the order of 2,700 incidents to review. The initial analysis was of the fire events, but it is acknowledged that smoke incidents can be a precursor for fire events. Work will continue, to sort and categorise the smoke/fume events to see if there are any significant variations to the trends seen in the fire events to date.

4 Research Work

This review includes international work that is currently underway to try and improve factors associated with aircraft fires, plus a review of work previously carried out and progress made to implement recommendations.

Aircraft fire research is concentrated in two areas, in-flight fires and post-crash fires.

- In-flight fires are reported, but most are not serious. Some have the potential to result in catastrophic loss of the aircraft. Catastrophic accidents caused by fires occurring during flight are very rare, but fire-fighting in the cabin is largely reliant on cabin crew via the provided manual equipment and training. If an in-flight fire becomes out of control, there is typically only around 15 minutes[1] before loss of control of the aircraft occurs.
- Post-crash fires are a frequent consequence of an accident. Although considerable efforts are made to ensure that effective airport fire-fighting services are available, the time taken to arrive at the accident site is a crucial factor in survivability. Many post-crash fires occur on or near airports but in only around 50% of accidents do fire-fighting resources arrive within four minutes[2].

Aircraft fire research internationally is dominated by work at the FAA Technical Center in Atlantic City. Whilst major aerospace manufacturers such as Boeing and Airbus spend substantial amounts on fire research, this generally relates to commercial activities and is usually not detailed in the public domain.

Recent CAA activities in this area (designated internally as the Fishbone exercise) resulted in a number of recommendations, many of which are still to be implemented.

It is important to note that not all external recommendations may be acceptable to the bodies that regulate civil aviation, often on a cost-benefit rationale. It is also important to note that identified safety risks that are not formally managed by the regulator are a business risk for the regulator.

Fire risks are an international issue and fire research is co-ordinated internationally, the main standing groups being the Materials Fire Test Working Group[3] and the International Aircraft Systems Fire Protection Working Group[4].

4.1 CAA 2008 Fishbone Exercise

The CAA 2008 Fishbone exercise produced two recommendations for fire-related research:

1. Carry out a review of recent research to ensure that CAA advice and guidance to fire fighters and aerodromes regarding accidents involving aircraft largely manufactured out of composite material is appropriate.

   Early work by the CAA[5] indicated that potential hazards required careful management; however, the proportion of composites in aircraft structures continues to increase. Furthermore, as composite technology evolves, the CAA needs to ensure that safety advice is relevant and up-to-date.

2. The development of better guidance on the carriage of Persons of Reduced Mobility (PRMs) such that in the event of fire, aircraft may be evacuated expeditiously.

There were three other issues that were worthy of further consideration:

- Improved lightning protection against in-flight fires – an EASA responsibility but work could be done to influence regulatory improvement.

1. Transportation Safety Board of Canada, *SR 111 Investigation – Recommendations*.
2. DOT/FAA/AR-09/18 *Determination of Evacuation and Fire Fighting Times based on an Analysis of Aircraft Accident Fire Survivability Data*.
3. http://www.fire.tc.faa.gov/materials.asp
4. http://www.fire.tc.faa.gov/systems.asp
5. PhD Thesis, E L Morrey, *Potential Hazards associated with Combustion of Polymer Composite Materials and Strategies for their Mitigation*, 2001.

- Development of a panel removal tool to enable hidden fires in the cabin to be dealt with more effectively.
- Compressed air foams – would be a natural add-on to the current foam research, which is aimed at agreeing an ICAO specification for improved new-generation foams (to be designated Level C).

All of the above were 'new' potential issues, in addition to the original Fishbone exercise from which a number of issues remain. Appropriate topics have been incorporated into this report's recommendations.

4.2 **Royal Aeronautical Society / Guild of Airline Pilots and Navigators – Recommendations for Reducing the Severity and Effects of In-Flight Fires**

The Royal Aeronautical Society (RAeS) and Guild of Airline Pilots and Navigators (GAPAN) published the most recent summary of in-flight aircraft fire issues[6] in 2007. Many of the recommendations remain to be actioned; however, where appropriate, they have been incorporated within the recommendations of this report. Appendix 6 shows a summary of the recommendations made by RAeS/GAPAN.

4.3 **Airline Pilots Association (ALPA) Views**

ALPA has a strong interest in fire issues. Their concerns cover the issues regarding the carriage of lithium batteries, problems with fire-fighting in aircraft, and ALPA's recommendations for industry-wide implementation of the revised smoke/fire/fumes (SFF) crew checklists and aircraft SFF prevention and detection systems (for both cargo and passenger operations).

A particular concern is that flight crew do not have effective aircraft system feedback on the threat posed by a fire. At present, flight crew are largely reliant on cabin crew reports in the event of fire.

4.4 **FAA Technical Center Research Programme**

The FAA's Fire Safety Branch conducts, manages and supports research programs to improve fire safety in commercial transport aircraft. The research comprises two separate but complimentary programmes: Fire and Cabin Safety, and Fire Resistant Materials. Fire and Cabin Safety is a near-term programme that addresses specific aircraft applications and/or problems, whereas Fire Resistant Materials is a long-range programme to develop the enabling technology for ultra-fire-resistant interior materials.

The Airport Technology Research and Development Branch[7] of the FAA covers post-crash issues.

As of October 2009, the FAA fire studies library[8] included 722 reports, indicating the depth of knowledge available in this area. However, fire issues are far from being completely characterised and substantial opportunities for improvement through research remain.

In addition to Fire Resistant Materials the main long-term thrusts for driving down fire fatalities are:

- Integrated Fire Suppression Systems – this is the integrated use of on-board fire fighting resources, particularly the use of nitrogen inerting systems and water mists. Nitrogen extracted from air may be used for fuel tank inerting but also can

6. *Smoke, Fire and Fumes in Transport Aircraft. Past history, current risk and recommended mitigations.* J M Cox, Safety Operating Systems, Royal Aeronautical Society, February 2007.
7. http://www.airporttech.tc.faa.gov/safety/resfire.asp
8. http://www.fire.tc.faa.gov/reports/listresults.asp?searchList=all&listSubmit=Submit

be used in conjunction with water mists for cargo fire suppression. Water mist used for the cargo area may also be used for the cabin or other areas.

- Post-Crash Rescue – improved foams and cabin interior fire-fighting may allow more emphasis on rescue. This is particularly an issue on new-generation large aircraft where the interior conditions are likely to present a wider variety of survivability conditions.

4.5 Aerospace Manufacturers' Views

Although detailed research interests may be commercially sensitive, research topic areas are generally available. For example, Airbus[9] have research interests in:

- materials in hidden areas;
- smoke/fire detection systems;
- halon replacements in cargo compartments;
- halon replacement in engines and APU;
- alternatives to oxygen on board.

Boeing analyse smoke and burning events[10] reported to them and publish results by aircraft model, allocating a Root Cause Code to each event. For example, the major cause of smoke and burning events on the B757, from July 2004 to August 2008, was a recirculation fan with 22 events whereas galley oven fires were reported only six times.

4.6 AAIB and NTSB position

At the time of writing, the AAIB had one open recommendation[11] (a duplicate recommendation is addressed to FAA) relating to fire – *(2007-002) 'It is recommended that EASA consider requiring, for all large aeroplanes operating for the purposes of commercial air transport, a system to enable the flight crew to identify rapidly the source of smoke by providing a flight deck warning of smoke or oil mist in the air delivered from each air conditioning unit'.*

This recommendation was not directly related to fire in the aircraft but smoke being delivered by the air conditioning system.

The NTSB position[12] is generally positive on actions taken as a result of accidents, usually by the FAA. Through the process of investigating aircraft accidents and incidents the NTSB identifies and scrutinises fire safety issues. In recent years the NTSB has been involved in the investigation of fuel tank explosions and has been advocating the use of fuel tank inerting technologies. From recent investigations of in-flight fires, issues relating to fire detection and suppression in cargo aircraft are being addressed, in addition to flight crew response to hidden fires. A relatively new issue that has been identified is the rise in fire incidents involving high-energy-density batteries in carry-on portable electronic devices.

4.7 Climate Change

There is emerging evidence that climate change is likely to substantially increase the incidence of lighting strikes. Although lightning-induced fires are rare, the combination of climate change and the future use of largely composite aircraft raise questions about the extent to which aircraft will be protected in the future.

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9. http://www.fire.tc.faa.gov/2007Conference/files/General_Fire/TueAM/PetitAirbus/PetitAirbusPres.pdf
10. http://www.boeing.com/commercial/aeromagazine/articles/qtr_01_09/pdfs/AERO_Q109.pdf
11. http://www.aaib.gov.uk/cms_resources.cfm?file=/AAIB%20Progress%20Report%202008.pdf
12. http://www.fire.tc.faa.gov/2007Conference/files/General_Fire/TueAM/KollyNTSB/KollyNTSBPres.pdf

5 Fire and Smoke Safety Performance Indicators (SPIs)

There are two types of SPI proposed. The first are high-level indicators monitoring the number and rate of fire and smoke events on UK public transport aeroplanes. The second, lower-level SPIs, are to monitor fire and smoke events involving each of the cabin, electrical systems, landing gear and APU / uncontained engine failures. The SPIs are intended to monitor the effectiveness of initiatives to reduce fire and smoke events.

An example of the first type of SPI is shown in Figure 5, covering the same ten-year period as other statistics in this report. One challenge is that the MOR coding does not differentiate between smoke and fumes, so the number of smoke events may decrease substantially once further work is completed.

In terms of timescales for the development of the SPIs, the high-level indicator will be developed alongside the other six task force SPIs. It is necessary to coordinate their development to ensure that they provide comparable information, enabling prioritisation of recommendations across all seven task forces. Appendix 9 shows the progress made so far on the development of SPIs. Further analysis will continue to assess all smoke/fume events and following completion of this task, the SPIs will be finalised.

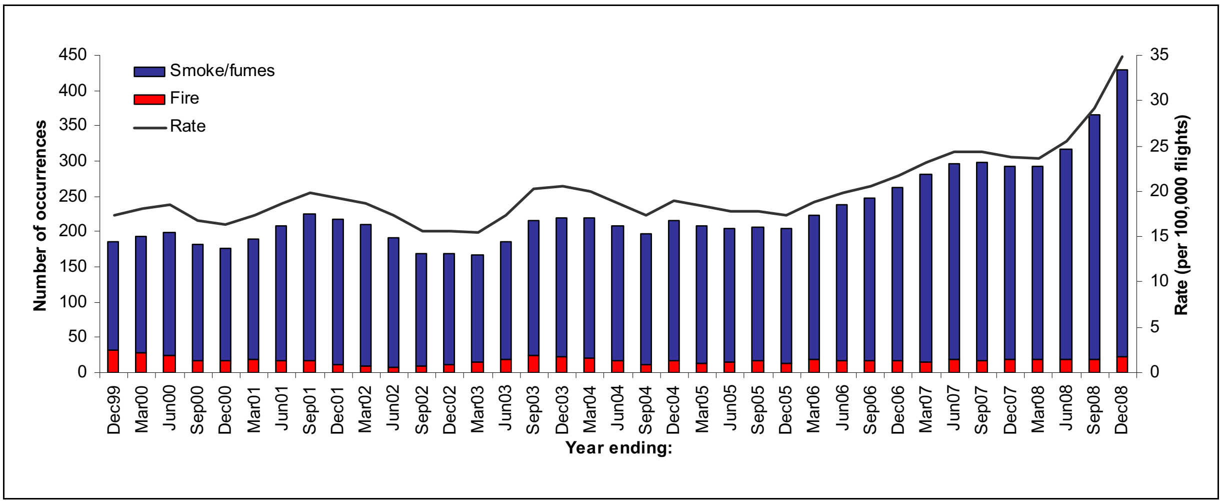

Figure 5 Number and Rate of Fire and Smoke/Fume Events

6 Summary of Recommendations and Safety Improvement Projects

Recommendations and potential CAA SIPs proposed by the task force are shown in Appendix 11. Below is a summary of these recommendations. The format of the recommendations shown in the appendix was determined by the SRT to ensure a standardised approach from the task forces.

6.1 Recommendation APCFTF01:

The CAA should consider initiating a SIP to investigate the occurrence rate of hidden-area fires and to investigate technical options for low-cost hidden-area fire detection.

6.2 Recommendation APCFTF02:

The CAA should initiate a SIP to consider the feasibility and potential cost benefit of identifying differing smells, fumes and smoke in the cabin and secondly, to examine commercially available equipment to see if suitable equipment is likely to be operationally effective.

6.3 **Recommendation APCFTF03:**

The CAA should initiate a SIP to review cabin fire-fighting equipment, define suitable tools for cabin panel removal that cannot be misused and investigate the introduction of fire ports that would allow the discharge of extinguishers to some hidden areas of the cabin.

6.4 **Recommendation APCFTF04:**

The CAA should initiate a SIP to consider cabin crew communications in the event of fire.

6.5 **Recommendation APCFTF05:**

The CAA should initiate a SIP to review the latest understanding of the lightning environment.

6.6 **Recommendation APCFTF06:**

The CAA should consider initiating a SIP to raise fire safety awareness through a campaign to Engineering and associated groups on the effect of fire/smoke events on aircraft caused by poor workmanship or inadequate quality control.

6.7 **Recommendation APCFTF07:**

The CAA should consider initiating a SIP to raise fire safety awareness through a campaign to Flight Operations and associated groups on the effect of fire/smoke events on aircraft caused by inadequate quality control

6.8 **Recommendation APCFTF08:**

The CAA should consider initiating a SIP to produce guidance material for operators on the processes associated with aircraft oven servicing and the suitability of heated food procedures.

6.9 **Recommendation APCFTF09:**

The CAA should consider initiating a SIP to provide greater / focused sampling during Cabin Safety Flight and Ramp Inspections on servicing and in-flight oversight of toilet supplies and storage of the same.

6.10 **Recommendation APCFTF10:**

The CAA should consider initiating a SIP to collaborate with other interested parties in defining acceptable levels of contamination in hidden areas.

6.11 **Recommendation APCFTF11:**

The CAA should consider initiate a SIP to continue its support of the development of more effective fire-fighting foams

6.12 **Recommendation APCFTF12:**

The CAA should consider initiating a SIP to provide continued involvement in international fire/smoke working groups to ensure that UK fire safety concerns are considered.

7 Recommendations Considered but not Taken Forward

7.1 **The CAA should consider initiating a SIP to ensure that (PRMs) have their needs fully considered to the latest disabled standards, by working with other regulatory agencies.**

This recommendation came out of the CAA Fishbone Working Group in 2008. However, since that time, a member of the CAA Cabin Safety Office has been acting as the gateway for the SRG on PRM issues, working with the CPG, ERG and DfT. The Cabin Safety Office have worked with the DfT to produce a Code of Practice, liaised with ECAC to enhance guidance material in ECAC *Doc 30* and held discussions with the US DoT regarding harmonisation with the USA.

EASA have commissioned research into the Carriage of Special Categories of Passengers, which includes PRMs. The resulting report has been finalised and includes recommendations that numbers of PRMs on each flight should be limited to improve their survival chances. EASA are reviewing the report but it is unlikely that any guidance will result in the near future – it will go through the usual RIA and CRD processes.

Based on this work, it was considered that this recommendation has been addressed.

7.2 **The CAA should consider initiating a SIP to review the latest work on fires in composite structures.**

Airport fire fighters wear protective breathing equipment as part of their operating procedures in tackling an aircraft fire. In addition, the regulating agencies have issued Special Conditions to be met where aircraft are made substantially of composite materials. These special conditions include the production of guidance to the airport fire services, e.g. this text is included in the B787 Special Condition:

"For example, where the effects of fire on the composite fuselage could result in delays in the action of rescue crews, or increased danger to them, due to potential weakening of the aircraft during their rescue effort, additional training material should be developed by Boeing for use by airport fire services."

At the seventh meeting of the ICAO Rescue and Fire Fighting Working Group (RFFWG) held in Montreal in March 2010 following a discussion on the use of composite materials in aircraft construction, the ICCAIA representatives (from Boeing and Airbus) agreed to research the issue and report back in six months.

Based on the above actions the working group felt that this issue was being adequately addressed at this time.

7.3 **The CAA should consider initiating a SIP to assess the risk of smoke or fire caused by Portable Electronic Devices (PEDs) in the cabin.**

This recommendation was raised out of concerns regarding the number of PEDs in the cabin and the potential of them causing or aggravating a fire in an overhead locker, for example. The task force carried out further research on the number of occurrences received through the MOR scheme and initial indications show a low occurrence rate. It is accepted that the proliferation of PEDs is increasing but counter to this, the size and power consumption of PEDs is generally decreasing and hence the risk of fire is reduced. PEDs generally overheat when they are switched on or during charging. PEDs are not normally enclosed at these times and furthermore, the risk of fire from a PED that was switched off and not being charged was also thought to be low. If a PED does overheat and cause smoke or fire, guidance material on how to tackle a PED/laptop fire is available through the FAA Fire Safety website at www.fire.tc.faa.gov.

8 Industry Feedback

The content of this report and recommendations have been shared with industry, both through e-mail correspondence and meetings at Aviation House. Industry provided a significant contribution to the formation of the recommendations, particularly in the areas where they feel the greatest dangers are. The contributions from industry have been limited in the later stages of the development of the recommendations; however, it is acknowledged that the recommendations have changed little since their initial drafts. It must be emphasised that industry involvement is seen as being critical to the success of any safety initiatives to be adopted.

9 Implementation

It is proposed that the task force will effectively step back from the core work of implementing the recommendations, but keep an oversight of actions being taken to ensure that the work being carried out is meeting the intent of the recommendations.

10 Future Actions

10.1 The Airborne and Post-Crash Fire task force has completed their review of fire events and has developed recommendations for consideration by the SRT. The recommendations have been weighted, as part of the process for assessing which ones will be accepted for further work.

10.2 The SPIs suggested in this report cannot easily be populated with incident data due to the coding of MORs. This is a generic concern of many of the task forces but needs to be followed up, to ensure that measures are available to monitor the success of recommendations made. The task force will continue working with Strategic Analysis to develop effective SPIs.

10.3 Work will continue regarding the monitoring of fire and smoke SPIs and discrete incidents as required; this will be done through a six-monthly workshop with task force members. All task force members will be included in correspondence and will be sent minutes of meetings.

10.4 Present recommendations to industry regarding the initiatives being taken to address fire and smoke safety concerns.

Appendix 1 Terms of Reference

Introduction

The purpose, composition, functions and procedures of the task force are described below. The task force has responsibility for the revision and administration of these Terms of Reference, for SRT approval.

Working Arrangements of the Task Force

- **Title**

Airborne and Post-Crash Fire Task Force

- **Purpose**

To review the contributing factors in accidents and high-severity occurrences leading to airborne or post-crash fires on public transport aircraft >5,700 kg.

- **Key Tasks**
  - Perform a literature review of work already completed or underway in this area, both at the CAA and externally.
  - Undertake a systematic analysis of risks relating to airborne or post-crash fires and create strategies for monitoring and reducing these risks.
  - Develop SPIs, in conjunction with Strategic Analysis, for identifying trends or causal factors in airborne and post-crash fires.
  - Make recommendations to the SRT.
  - Present recommendations to the Safety Conference.
- **Membership**

Membership comprises a chairman and secretary (together forming the secretariat), CAA specialists and representatives from the airline industry.

The secretariat will be from Airworthiness Strategy and Policy.

CAA specialists from the following areas will be represented:

– Strategic Analysis

– Flight Operations

– Aerodromes Standards

– Aircraft Certification

- **Meeting Frequency and Duration**

Frequency and duration of meetings will be discussed at the first meeting.

- **Deliverables and Timescales**
  - Develop SPIs for airborne and post-crash fires.
  - Deliver a presentation to industry Training Managers at a conference in November 2009. Completed.
  - Produce an SRT Paper and summary paper to be sent to the SRT Secretary by 20 January 2010, and reviewed at the 01/10 meeting that will be held on 27 January 2010.

For the Safety Conference itself, the following should be completed and presented:

- a review of data and any key findings;
- a recommended SPI(s) for adoption;
- responses to all previous Fishbone and SPI 2 WG recommendations;
- recommendations for ways forward and how these recommendations can be implemented as safety planning actions.

Records

- Meeting Notes

Minutes of each meeting will be kept and stored on ERM.

- **Actions**

Actions will be noted in the minutes and reviewed periodically with team members, either at meetings or through correspondence if attendance at one of the meetings was not possible.

Appendix 2 Task Force Membership

Current membership / post holders of the task force:

- **Secretariat**

Graham Wheeler (Chairman) – CAA Airworthiness Strategy and Policy

- **CAA Specialists**

Rowan Christou – Strategic Analysis

Graham Greene – Strategic Analysis

Malcolm Kavanagh – Flight Operations (Aeroplanes)

Kevin Payne– Flight Operations (Helicopters)

Cliff Barrow – Aircraft Certification

Ian MacLaren – Aircraft Certification

Simon Webb – Aerodrome Standards

Simon Wells – Flight Operations (Cabin Safety Office)

- **Industry Representatives**

Hazel Corcoran – Thomas Cook

John Pearman – flybe

Chris Lennon – TAG Aviation

Helen McCarry – British Airways – Cabin Crew

Shane Howes – British Airways – IFE

Tendai Mutambirwa – easyJet

Appendix 3 Summary of Worldwide Fatal Accidents with Fatalities caused by Fire between January 1998 and December 2008

Accident data is for aeroplanes above 5,700 kg maximum take-off weight (MTOW), for all types of operation (except government) and 'normal' accidents (i.e. not violence or sabotage).

Following the task force's review of the accidents, the CAA's Accident Analysis Group (AAG) held its annual meeting and a further two accidents were classified as post-crash fire. These accidents are shown in Table 2.

Table 1 Worldwide Fatal Accidents involving Fire, 1998-2007

Date	Aircraft Type	Accident Description	Type of fire
05/05/1998	Boeing 737	Aircraft undershot runway on approach in poor weather. (near) Andoas, Peru. 88 POB, 75 fatal.	Post-crash fire
18/06/1998	**Fairchild (Swearingen) Metro**	**Lost control during approach following engine fire and hydraulic problems. Mirabel Airport, Montreal, Quebec, Canada. 11 POB fatal.**	**Fire due to aircraft systems and post-crash fire**

Table 1 Worldwide Fatal Accidents involving Fire, 1998-2007 (Continued)

29/08/1998	Tupolev Tu-154	Overran runway after rejected take-off. Mariscal Sucre Airport, Quito, Ecuador. 90 POB, 72 fatal, 10 on-ground fatal.	Post-crash fire
02/09/1998	**Boeing (McDonnell-Douglas) MD-11**	**Aircraft crashed into the sea after declaring emergency due to on-board fire. 5 NM off Peggy's Cove, Nova Scotia, Canada. 229 POB fatal.**	**Fire due to aircraft systems**
11/12/1998	Airbus A310	Crashed during third attempt to land. Surat Thani Airport, Surat Thani, Thailand. 146 POB, 102 fatal.	Post-crash fire
04/02/1999	Antonov An-26	Aircraft overran end of runway following deep landing. Luzamba Airport, Luzamba, Angola. 36 POB, 2 fatal.	Post-crash fire
01/06/1999	Boeing (McDonnell-Douglas) MD-80	Aircraft overran end of runway on landing. National Airport (Adams Field), Little Rock, Arkansas, USA. 145 POB, 11 fatal.	Post-crash fire
22/08/1999	Boeing (McDonnell-Douglas) MD-11	Aircraft rolled inverted after wing struck ground just before touchdown. Chep Lap Kok International Airport, Hong Kong. 315 POB, 3 fatal.	Post-crash fire
31/08/1999	Boeing 737	Aircraft overran end of runway following several failed attempts to get airborne. Aeroparque Jorge Newbery, Buenos Aires, Argentina. 100 POB, 63 fatal, 2 on-ground fatal.	Post-crash fire
05/12/1999	Ilyushin Il-114	Aircraft crashed following loss of control shortly after take-off. Domodedovo Airport, Moscow, Russia. 7 POB, 5 fatal.	Post-crash fire
16/02/2000	Boeing (McDonnell-Douglas) DC-8	Control was lost whilst attempting to return following severe centre-of-gravity problem. (near) Sacremento, USA. 3 POB fatal.	Post-crash fire
17/07/2000	Boeing 737	Aircraft undershot the runway during final approach. Aneeshabad District, Patna, India. 58 POB, 55 fatal, 5 on-ground fatal.	Post-crash fire
25/07/2000	**Aerospatiale Concorde**	**Control was lost shortly after take-off and following the loss of at least one engine. Gonesse, (near) Paris, France. 109 POB fatal, 4 on-ground fatal.**	**Fire due to aircraft systems and engine fire or overheat**
31/10/2000	Boeing 747	Aircraft was destroyed after hitting obstructions while attempting to take-off from a closed runway. Chiang Kai Shek International Airport, Taipei, Taiwan. 179 POB, 83 fatal.	Post-crash fire
31/01/2001	Aerospatiale Caravelle	Aircraft broke up and caught fire during forced landing following diversion due to undershoot at original destination. (near) El Yopal, Colombia. 6 POB, 3 fatal.	Post-crash fire

Table 1 Worldwide Fatal Accidents involving Fire, 1998-2007 (Continued)

03/03/2001	**Boeing 737**	**Aircraft was destroyed by an explosion and fire whilst on the stand. Bangkok International Airport, Bangkok, Thailand. 5 POB, 1 fatal.**	**Fire due to aircraft systems**
08/10/2001	Boeing (McDonnell-Douglas) MD-80	Aircraft was destroyed by impact and post-impact fire when it struck another aircraft at a late stage in its take-off run. Linate Airport, Milan, Italy. 110 POB fatal, 4 on-ground fatal, 4 on other aircraft fatal.	Post-crash fire
24/11/2001	BAE Systems (Avro) RJ Avroliner	Aircraft was destroyed by impact and post-impact fire when it crashed during the final stage of a VOR/DME approach. Birchwil, (near) Zurich, Switzerland. 33 POB, 24 fatal.	Post-crash fire
15/04/2002	Boeing 767	Crashed into hill during circling approach into Pusan (near) Kimhae International Airport, Pusan, South Korea. 166 POB, 128 fatal.	Post-crash fire
04/05/2002	BAE Systems (BAC) One-Eleven	Crashed into residential area shortly after take-off from Kano Airport. Gwammaja district, Kano, Nigeria. 77 POB, 73 fatal, 74 on-ground fatal.	Post-crash fire
08/01/2003	BAE Systems (Avro) RJ Avroliner	Aircraft undershot runway during the final stage of VOR/DME approach. Diyarbakir, Turkey. 80 POB, 75 fatal.	Post-crash fire
06/03/2003	Boeing 737	Aircraft crashed shortly after take-off following no.2 engine failure. Aguemar Airport, Tamanrasset, Algeria. 104 POB, 103 fatal.	Post-crash fire
13/01/2004	Yakovlev Yak-40	Aircraft touched-down beyond the end of the runway and struck obstacles Vostochny Airport, Tashkent, Uzbekistan. 37 POB fatal.	Post-crash fire
10/02/2004	Fokker 50	Aircraft crashed during approach to Sharjah. (near) Sharjah, United Arab Emirates. 46 POB, 43 fatal.	Post-crash fire
04/03/2004	Ilyushin Il-76	Aircraft crashed after control was lost shortly after take-off Baku Airport, Baku, Azerbaijan. 7 POB, 3 fatal.	Post-crash fire
11/05/2004	**Antonov An-12**	**Aircraft crashed in thunderstorm. 6 miles North of Hugrat al Wazin, East of Dilling, Sudan. 7 POB, 7 fatal.**	**Engine fire or overheat and post-crash fire**
02/06/2005	**Antonov An-24**	**Aircraft crashed following an aborted take-off reportedly due to an engine fire. Khartoum Airport, Khartoum, Sudan. 42 POB, 7 fatal.**	**Engine fire or overheat**
05/09/2005	Boeing 737	Aircraft crashed in a residential area after failing to gain altitude after take-off. Polonia Airport, Medan, Indonesia. 117 POB, 104 fatal, 44 on-ground fatal.	Post-crash fire

Table 1 Worldwide Fatal Accidents involving Fire, 1998-2007 (Continued)

10/12/2005	Boeing (McDonnell-Douglas) DC-9	Aircraft crashed on landing in stormy weather. Port Harcourt International Airport, Port Harcourt, Nigeria. 111 POB, 109 fatal.	Post-crash fire
07/07/2006	**Antonov An-12**	**Aircraft crashed shortly after the no.3 engine caught fire during climb-out. (near) Goma, Congo (Democratic Republic). 6 POB fatal.**	**Engine fire or overheat**
09/07/2006	Airbus A310	Aircraft overran end of runway on landing and collided with the concrete airport perimeter wall. Irkutsk International Airport, Irkutsk, Russia. 203 POB, 126 fatal.	Post-crash fire
27/08/2006	Bombardier (Canadair) CRJ Regional Jet	Aircraft overran end of runway whilst attempting to take off from the wrong runway. Blue Grass Airport, Lexington, Kentucky, USA. 50 POB, 49 fatal.	Post-crash fire
01/09/2006	Tupolev Tu-154	Aircraft ran off side of runway during landing roll. Shahid Hashemi Nejad International Airport, Mashad, Iran. 160 POB, 28 fatal.	Post-crash fire
10/10/2006	BAE Systems (HS) 146	Aircraft overran end of runway on landing and fell down a steep, wooded slope. Sorstokken Airport, Stord, Norway. 16 POB, 4 fatal.	Post-crash fire
29/10/2006	Boeing 737	Aircraft crashed shortly after take-off in gusty wind conditions. Abuja International Airport, Abuja, Nigeria. 105 POB, 96 fatal, 1 on-ground fatal.	Post-crash fire
07/03/2007	Boeing 737	The aircraft overran the runway following a (fast and high) unstabilised approach. Adisutjipto Airport, Yogyakarta, Jawa, Indonesia. 140 POB, 22 fatal.	Post-crash fire
17/05/2007	**Aircraft Industries - Let L-410 Turbolet**	**Engine failure after take-off. (near) Kilambo, Congo (Democratic Republic). 3 POB fatal.**	**Engine fire or overheat**

Table 2 Worldwide Fatal Accidents involving Fire, 2008 (reviewed at the 14 October 2009 AAG Meeting)

Date	Aircraft Type	Accident Description	Type of fire
10/06/2008	Airbus A310	Aircraft overran the runway and caught fire. Khartoum International Airport, Khartoum, Sudan. 214 POB, 33 fatal.	Post-crash fire
20/08/2008	Boeing (McDonnell-Douglas) MD-80	Aircraft failed to climb after take-off, crashed and was destroyed by fire. Barajas International Airport, Madrid, Spain. 172 POB, 154 fatal.	Post-crash fire

Appendix 4 Summary of UK High-Severity Mandatory Occurrence Reports involving Fire, 1999–2008

A summary is presented below of the high-severity MORs involving fire on large public transport aeroplanes that were either UK-registered, UK-operated or at a UK-licensed aerodrome. The occurrences shown cover the ten-year period 1999 to 2008.

Table 3 High-Severity MORs

Date	Aircraft Type	Location	Description
12/01/1999	Fokker F27 Friendship	Guernsey	Reportable accident: Aircraft stalled on approach and struck houses. Stall caused by aircraft operation outside of weight and balance limitations. Post-crash fire. 2 POB fatal.
22/12/1999	Boeing 747	Stansted	Reportable accident: Aircraft crashed on take-off from Stansted and was destroyed by impact/fire. 4 POB fatal.
02/05/2000	Learjet	Lyon	Reportable accident: Aircraft caught fire on landing, following diversion due to engine problems en route. 5 POB, 2 crew fatalities, 3 passenger minor injuries.
04/01/2002	CL600 Challenger	Birmingham	Reportable accident: Shortly after becoming airborne aircraft rolled left and wingtip clipped ground. Aircraft cartwheeled and caught fire. 5 POB fatal.
08/11/2002	Boeing 737	Clacton	Serious incident: "Mayday" declared due to fire/smoke in cockpit/cabin. Aircraft returned and landed safely. Fire caused by electrical arcing in the ceiling panel aft of the cockpit door.
18/10/1999	Boeing 767	London Gatwick	Engine failure at 300 ft due to bird strike. Severe vibration, flames evident. "Mayday" declared, aircraft returned. Fan blade damage.
20/01/2007	Falcon 900	London Gatwick	Reportable accident: "Mayday" declared due to no.3 engine fire. Aircraft diverted and landed safely. No injuries to two POB. AAIB field investigation.

There were also a number of AAIB-categorised reportable accidents and serious incidents within the MOR grades C and D. These are detailed in Table 4.

Table 4 Grade C and D MOR Reportable Accidents and Serious Incidents

Date	Aircraft Type	Location	Description
09/04/1999	Concorde	New York JFK	Serious incident: No.1 engine fire warning during climb. Engine shut down. "Mayday" declared. Fuel dumped. Aircraft returned. Second stage (fuel) pump leaking.
25/07/1999	Hunter	Luton	Reportable accident: LH main landing gear failed to extend. Diverted to Luton and landed safely. Damage to left wingtip, flap and drop tank. No injury to 1 POB.

Table 4 Grade C and D MOR Reportable Accidents and Serious Incidents (Continued)

05/06/2001	Fokker F27 Friendship	Jersey	Reportable accident: Uncontained failure of LH engine shortly after take-off. Aircraft returned and landed safely.
06/09/2001	Embraer EMB 145	Glasgow	Serious Incident: "Mayday" declared due to no.1 engine fire warning in climb. Engine shutdown. Aircraft returned and landed safely.
19/11/2002	Boeing 727	Nottingham East Midlands	Serious incident: No.1 engine failed during take-off and subsequently caught fire. Take-off rejected and AFS deployed.
13/06/2003	Concorde	En Route	Serious incident: Fuel Quantity Indication (FQI) problems during the transatlantic cruise led to post-flight discovery of fire damage to wiring in the underwing area.
23/08/2003	BAE 146	Unknown	Serious incident: Smoke/fire in passenger compartment. Minor damage. 88 POB, no injuries. Burnt fluorescent light holder.
28/03/2004	Boeing 777	En Route	Serious incident: Fire discovered in toilet during flight. Fire extinguished by cabin crew – negligible damage.
11/08/2004	Boeing 777	Houston	Serious incident: High engine vibration on take-off. Smoke in cabin. Aircraft returned. Crew and passengers evacuated. Internal engine fire damage. NTSB investigation.
08/09/2004	Fokker F27 Friendship	Stansted	Serious incident: Take-off rejected due to failure of aircraft to maintain runway centreline and suspected LH engine fire.
01/03/2005	Boeing 777	Manchester	Reportable accident: LH main landing gear fire after landing. Emergency evacuation carried out.
11/07/2005	Boeing 767	London Gatwick	Reportable accident: Take-off rejected due to suspected no.1 engine problem. Small fires started in LH and RH MLG wheels. No injuries to 218 POB.
30/07/2005	Boeing 757	Nottingham East Midlands	Serious incident: Sparks/flames evident from RH MLG during touch-and-go landing. Circuit flown with gear down and aircraft landed safely. No. 3 brake unit failed.
28/05/2006	Airbus A330	Dubai	AAIB initial notification – serious incident: RH engine failure after take off. Aircraft returned. Engine fire not contained. No injuries to 221 POB. Subject to foreign authority investigation.
23/10/2006	Lockheed L1011 Tristar	Buenos Aires	AAIB initial notification – serious incident: Abnormal vibration/detonations/high EGT and flames from no.2 engine during climb. Diversion to Ezeiza. Subject to Foreign authority investigation.
29/08/2006	BAE 146	Ravensthorpe	AAIB initial notification – serious incident: Smell on flight deck (not oil-like) during climb followed by popping noises and bright yellow flashes behind escape rope panel. Subject to foreign authority investigation.

Table 4 Grade C and D MOR Reportable Accidents and Serious Incidents (Continued)

17/06/2007	Shorts SD360	Seychelles	AAIB initial notification – serious incident: No.1 engine failed on approach. Parts ejected through exhaust, which caught fire. Fire drill actioned successfully. No injuries to 30 POB. Seychelles authority investigation.
11/11/2007	BAE 146	Munich	AAIB initial notification – serious incident: Smoke/fire on flight deck. No reported damage or injuries. Subject to German authority (BFU) investigation.
29/05/2008	Airbus A330	Manchester	AAIB initial notification – reportable accident: Smoke from / damage to LH main landing gear after rejected take-off. Aircraft stopped on taxiway. Precautionary disembarkation. No injuries to 250 POB. Subject to AAIB field investigation.
08/07/2008	Boeing 737	Larnaca	Serious incident: In-flight engine shutdown. Aircraft diverted.

Appendix 5 Guidance Material available to Designers, Operators and Continuous Airworthiness Organisations for IFE Installations

In 2003 the JAA published *TGL 17*, which provides guidance to designers of IFE installations and to aircraft operators. It addresses topics including fire, smoke, EMC, the use of in-seat electronics, and continued airworthiness. All European IFE installations designed after 2003 should take account of *TGL 17*. Similarly, the FAA has issued a number of policy documents that address this subject. If the guidance given in the JAA and FAA documents is followed, then the number of IFE-related incidents and occurrences should be reduced.

Furthermore the JAA published guidance (*TGM/25/10*) addressing in-seat power supply installations which if followed, should minimise risks associated with these systems. There are also FAA policy documents available for these systems.

Appendix 6 Royal Aeronautical Society / Guild of Airline Pilots and Navigators – Recommendations for Reducing the Severity and Effects of In-Flight Fires

Summary of recommendations:

Equipment Design and Airworthiness

1. Evaluate aircraft for single-point failures of wiring and the potential effect on aircraft systems.
2. Improve the engineering and installation of wires so that their routing does not endanger, by proximity, any critical system wiring. Evaluate modifications using the same approval process for Supplemental Type Certificate modification as for Type Certificates.
3. Install arc fault circuit interrupter technology on new and existing transport aircraft.
4. Adopt continuous smoke testing for flight deck smoke evaluation tests for a type certificate.
5. Install fire access ports or dedicated fire detection and suppression systems in inaccessible areas of aircraft.

6. Review all existing and planned cabin interior materials and insulating materials surrounding the cabin, with the aim of specifying material that would produce less toxic fumes when subjected to heat.
7. Mark locations of minimal damage for access to inaccessible areas of the aircraft.
8. Increase the number and location of sensors to alert the flight crew of smoke/fire/fumes. These sensors should take advantage of new technology to minimise the frequency of false alarms.

Protective Equipment

1. Implement vision assurance technology for improved pilot visibility during continuous smoke on the flight deck.
2. Install full-face oxygen masks and provide sufficient flight crew oxygen for descent and landing during a smoke/fire/fume event.
3. Increase the size of flight deck and cabin fire extinguishers to five pounds of Halon or an equivalent effective agent.

Maintenance

1. Include in maintenance plans for all transport aircraft regular inspections of thermal acoustic insulation blankets and smoke barriers to insure cleanliness.
2. Modify maintenance procedures to minimise the possibility of contamination of thermal acoustic insulation blankets.
3. Improve wiring inspection maintenance programmes using new technology so as not to rely exclusively on visual inspection of wiring bundles.

Pilot Procedures

1. Implement flight crew procedures for using autoflight systems to reduce pilot workload. There should, however, be provisions in the procedures for the failure or un-serviceability of the autoflight system.
2. Eliminate procedures that call for the opening of flight deck windows to vent smoke. Improve smoke removal procedures accordingly to ensure maximum effectiveness.
3. Redesign all transport aircraft checklists pertaining to smoke/fire/fumes to be consistent with the Flight Safety Foundation smoke/fire/fume checklist template. Consider: memory items, prevention of checklist 'bottlenecks', font size and type, where information should be found (quick reference handbook (QRH) or electronic), smoke removal, number of checklists for smoke/fire/fumes, and the length of the checklists.

Flight Crew Training

1. Assure that flight crew training includes the proper use of a crash axe, the necessity of proper fire extinguisher operation including vertical orientation, the proper accomplishment (or abandonment) of the checklist during simulated smoke/fire/fume events, the importance of maintaining a smoke barrier during smoke/fire/fume events and the ineffectiveness of, and potential problems with, opening a flight deck window during realistic line-oriented recurrent flight training on a recurrent annual basis.

The co-operation of the regulators, manufacturers, air carriers, and professional associations is needed to implement these safety recommendations. Only through the execution of a comprehensive mitigation strategy along with developing and implementing a plan to maximise fleet coverage can the risk of in-flight smoke, fire and fumes be reduced to an acceptable level.

Appendix 7 Further Information on Aerodrome Planning

CAP 168, Chapter 9 sets out the emergency planning requirements for UK-licensed aerodromes and includes many references to the Civil Contingencies Act 2004 and its requirements. This includes a requirement for an aerodrome to be represented within local emergency management arrangements.

The CAA oversight of licensed aerodromes has focused on emergency planning since the Civil Contingencies Act 2004 was introduced and it continues to be a major area of focus during audits. Current work is in hand to enhance guidance in assessing difficult environs that present challenges to the emergency response in areas adjacent to approach and departure routes up to 1,000 m from the runway.

Safeguarding and Public Safety Zones

Aerodromes are also subject to 'safeguarding', which is linked to planning law and safeguards an established land use. Safeguarding is achieved by a process of checking proposed developments so as to:

- protect the blocks of air through which aircraft fly, by preventing penetration of surfaces created to identify their lower limits.
- protect the integrity of radar and other electronic aids to air navigation, by preventing reflections and diffractions of the radio signals involved.
- protect visual aids, such as approach and runway lighting, by preventing them from being obscured, or preventing the installation of other lights which could be confused for them.
- avoid any increase in the risk to aircraft of a birdstrike by preventing an increase in hazardous bird species in the vicinity of the aerodrome and, whenever the opportunity arises, to reduce the level of risk.

Information on any proposed development within the safeguarded area is assessed and either the development is:

- not objected to;
- not objected to subject to certain stated conditions; or
- objected to (with reasons given).

There is also guidance for planning authorities from the government on Public Safety Zones (PSZs). PSZs are areas of land at the ends of the runways at the busiest airports, within which development is restricted in order to control the number of people on the ground at risk of death or injury in the event of an aircraft accident on take-off or landing. The basic policy objective governing the restriction on development near civil airports is that there should be no increase in the number of people living, working or congregating in PSZs and that, over time, the number should be reduced as circumstances allow.

It is believed that the measures put in place in the UK and European arena go some way to addressing the aerodrome and local authority responses to an accident.

Appendix 8 Summary of Global Fatal Accidents and UK High-Severity Event Bar Charts

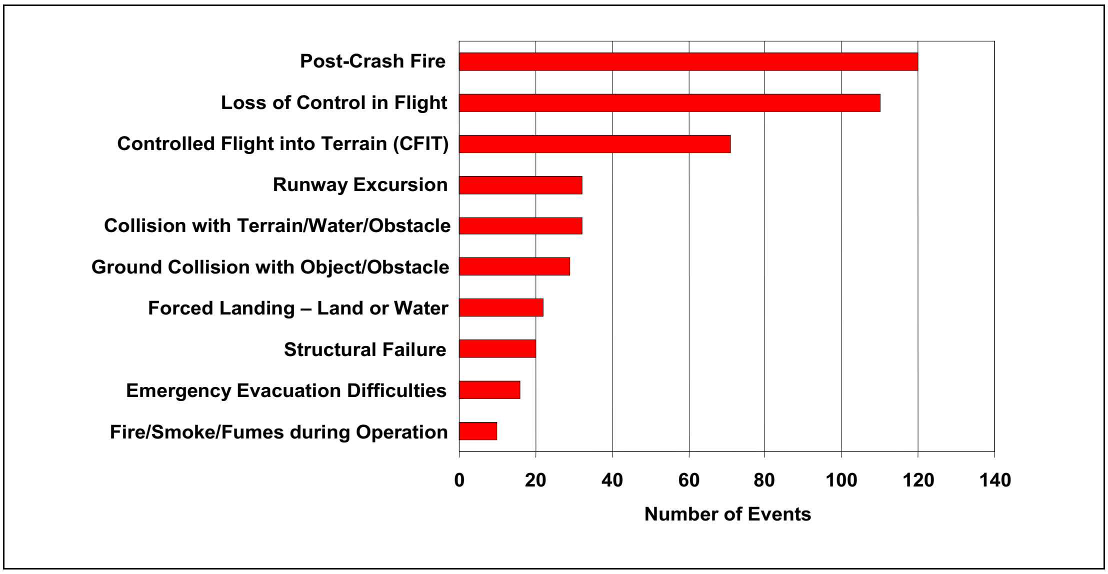

Figure 6 Top-ten Consequences for all Fatal Accidents for the Ten-year Period 1997 to 2006

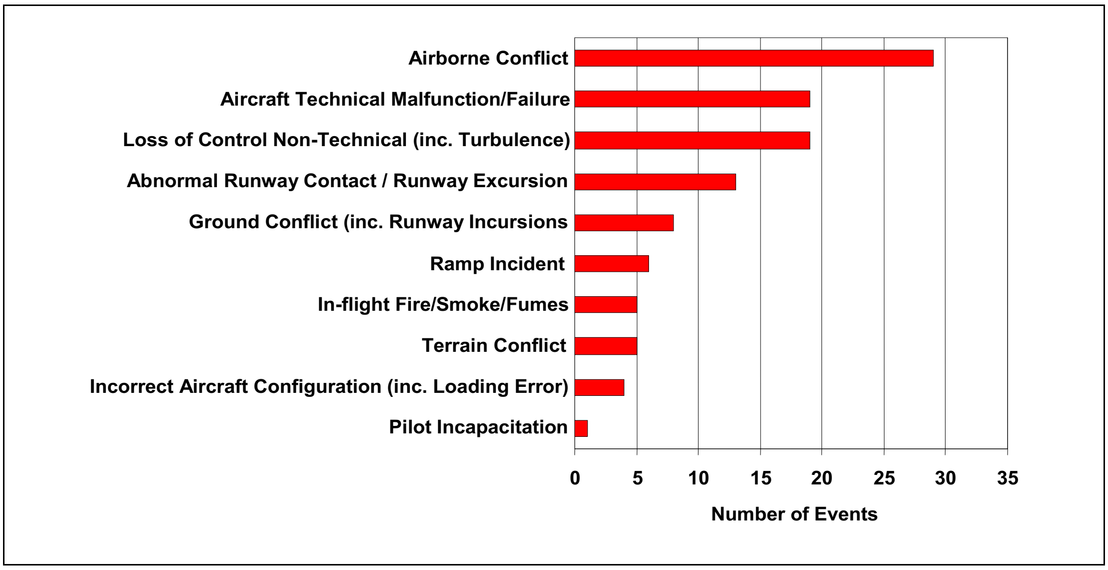

Figure 7 Top-ten THREAT Event Types – 2005 to 2008

Appendix 9 Summary of Fire SPIs – Progress Update

Progress so far

- Safety Data meeting: agreed to separate smoke and fumes; smoke event evolved to fire coded as fire?
- Smoke and fumes: 824 out of 2,042 occurrences analysed (separated, causal factors, compartment).
- Fire: all 239 occurrences analysed.

General observations

- Rate of fire, smoke and fumes occurrences* per million flights.

- Distribution of occurrences by type: fire, smoke, fumes and undefined.
- Occurrence type distribution over time.

Causal factors

- Smoke causal factors (824/2,042).
- Fumes causal factors (824/2,042).
- Fire causal factors.

*Includes MOR severity grades: A, B, C and D.

Results and graphs

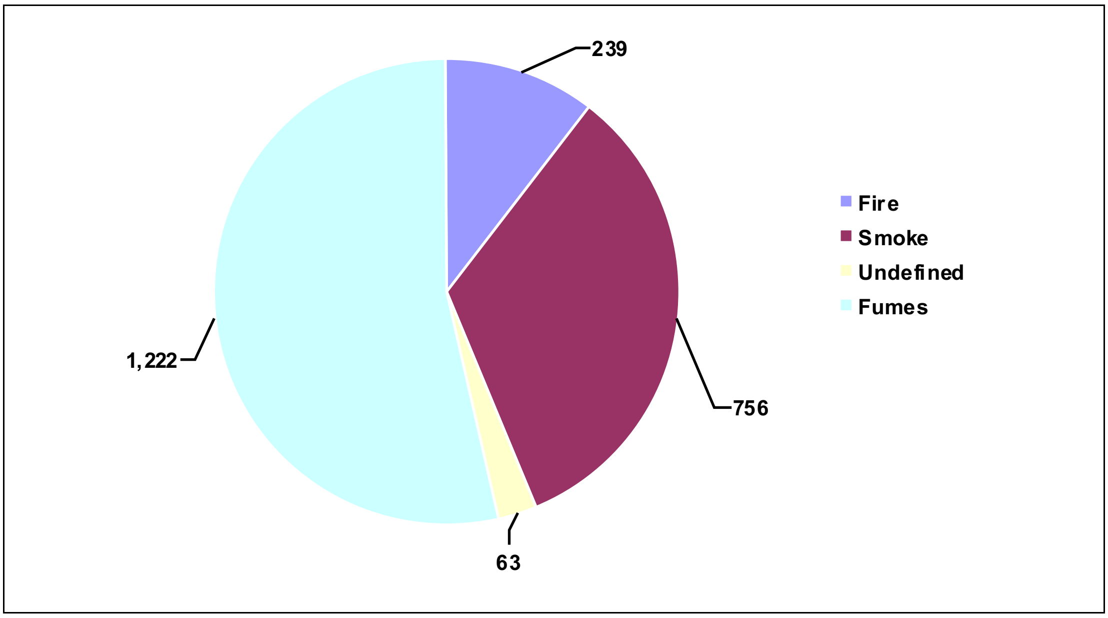

Figure 8 Distribution of Fire, Smoke and Fumes Occurrences

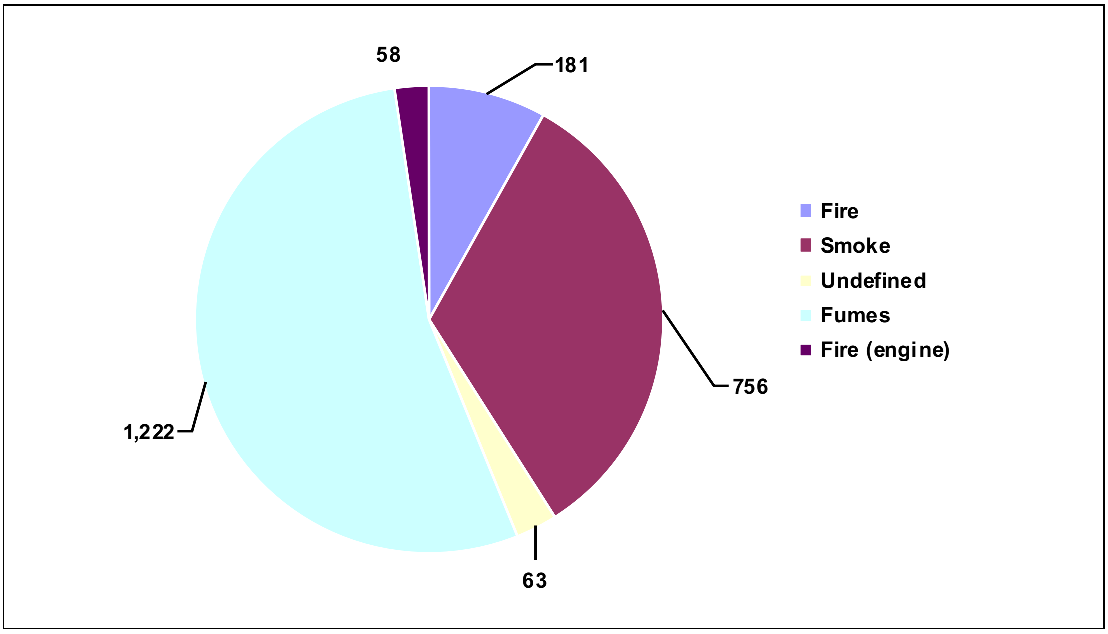

Figure 9 Distribution of Fire (including specifically engine fires), Smoke and Fumes Occurrences

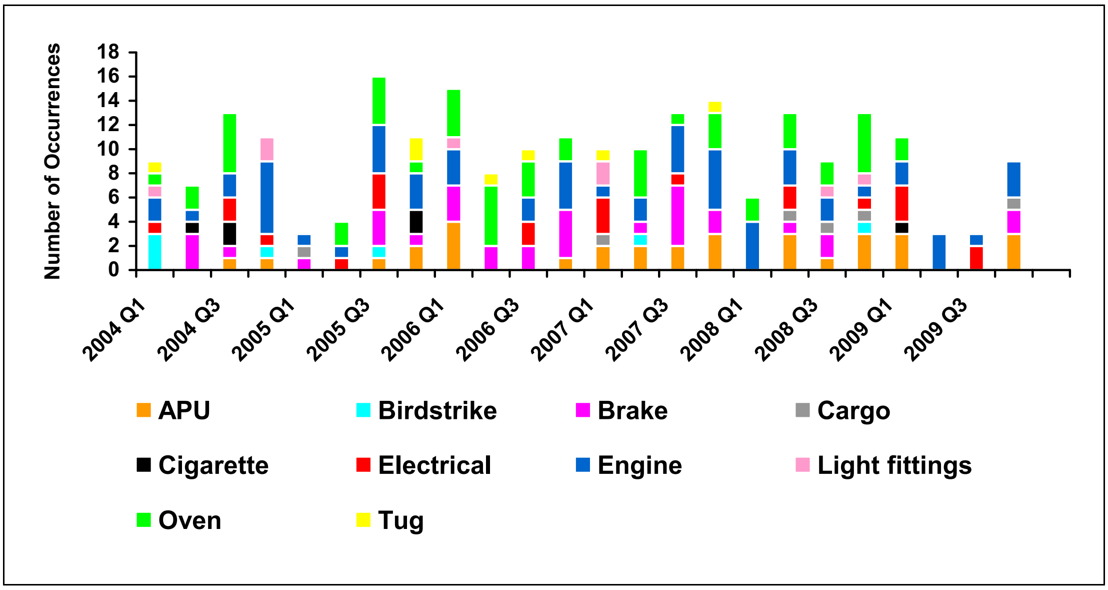

Figure 10 Fire Causal Factors – Distribution over Time

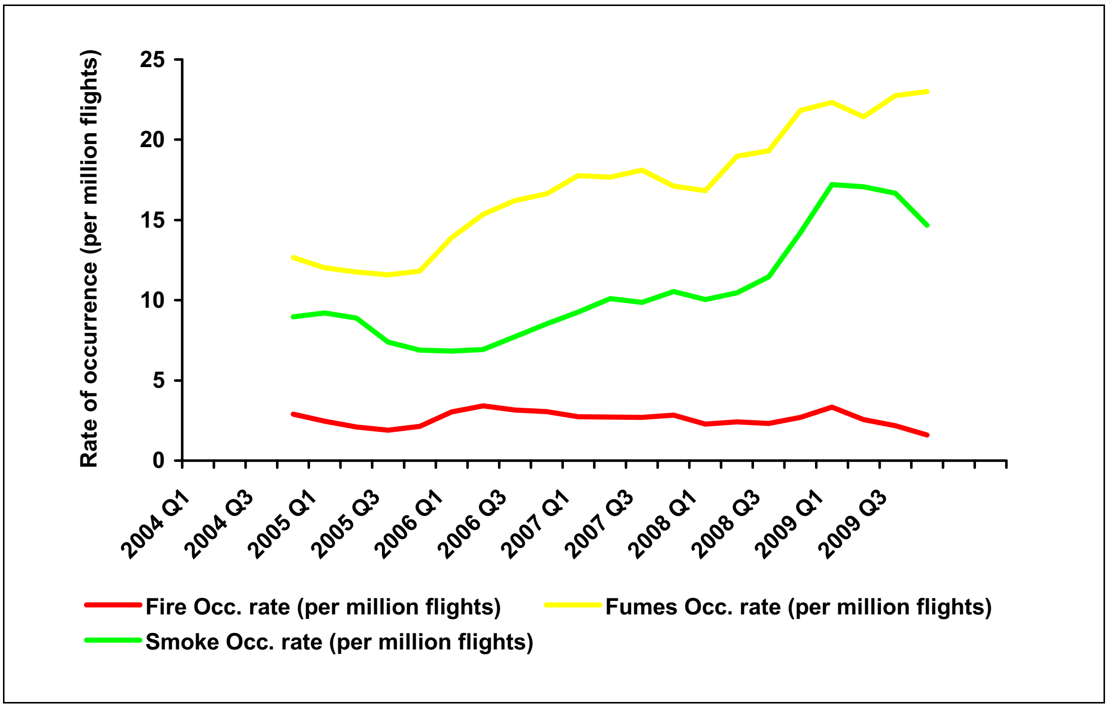

Figure 11 12-month Moving-Average Rates of Occurrence Types

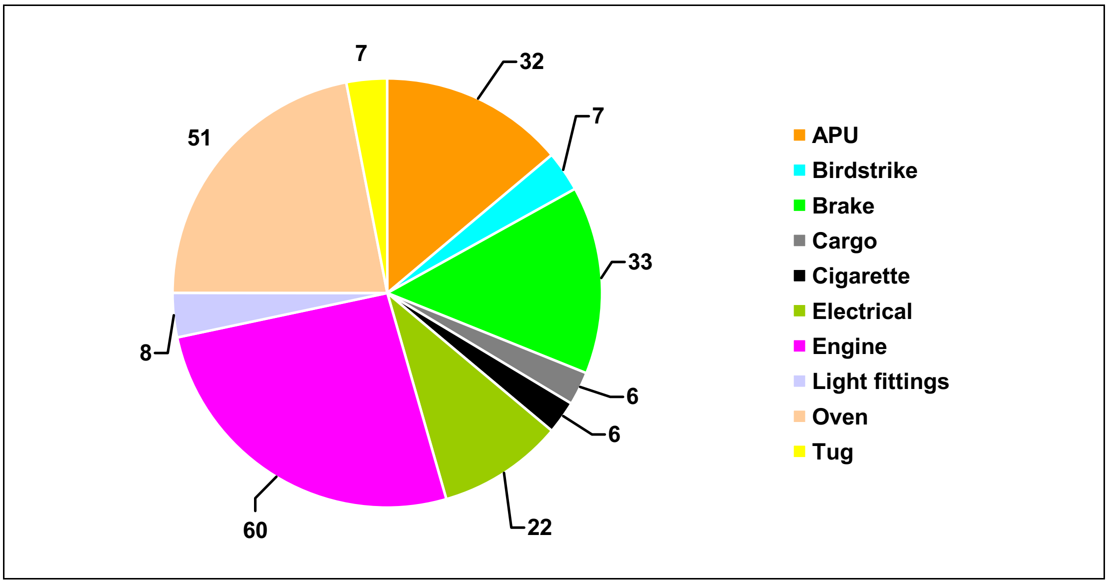

Figure 12 Fire Causal Factors – Distribution

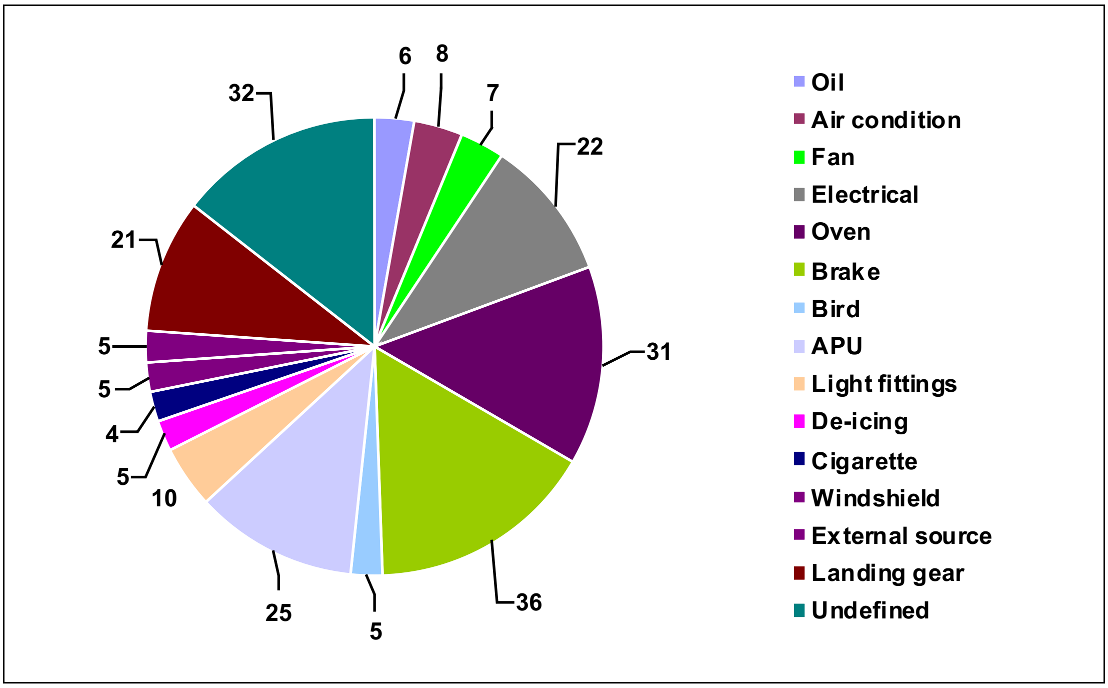

Figure 13 Smoke Causal Factors – Distribution (analysis so far)

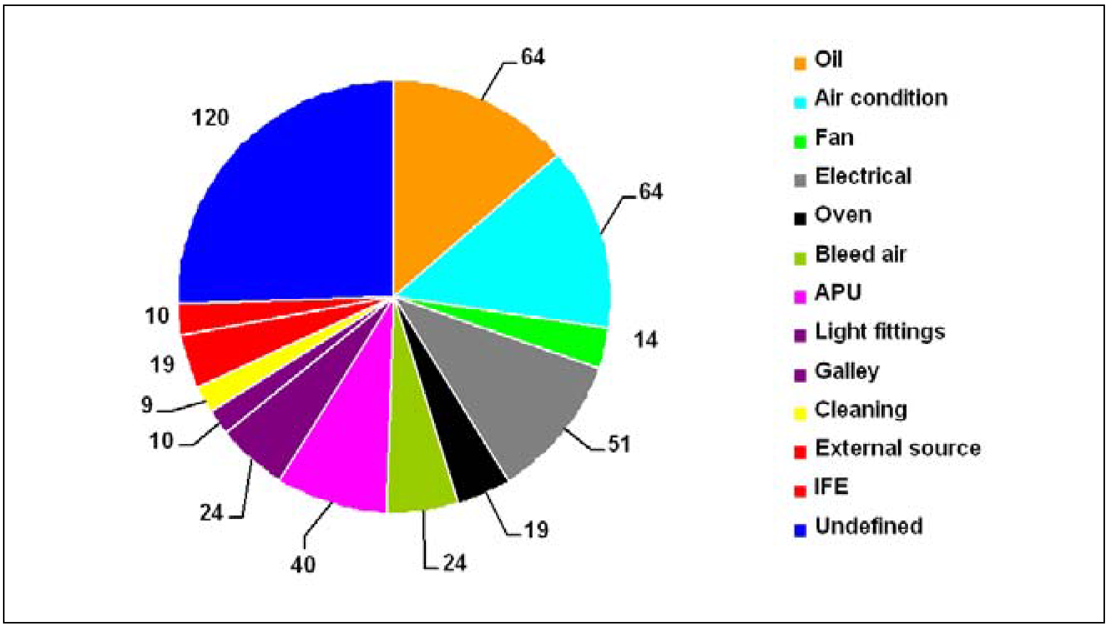

Figure 14 Fumes Causal Factors – Distribution (so far analysis)

Appendix 10 References

1. Transportation Safety Board of Canada, *SR 111 Investigation - Recommendations*
2. DOT/FAA/AR-09/18 *Determination of Evacuation and Fire Fighting Times based on an Analysis of Aircraft Accident Fire Survivability Data*
3. http://www.fire.tc.faa.gov/materials.asp
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5. PhD Thesis, E L Morrey, *Potential Hazards associated with Combustion of Polymer Composite Materials and Strategies for their Mitigation, 2001*
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9. http://www.fire.tc.faa.gov/2007Conference/files/General_Fire/TueAM/PetitAirbus/PetitAirbusPres.pdf
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11. http://www.aaib.gov.uk/cms_resources.cfm?file=/AAIB%20Progress%20Report%202008.pdf
12. http://www.fire.tc.faa.gov/2007Conference/files/General_Fire/TueAM/KollyNTSB/KollyNTSBPres.pdf

Appendix 11 Recommendations

Task Force: *(use drop-down list)*

Airborne and Post-Crash Fire

Recommendation Reference (e.g. LoCTF01):

APCFTF01

Recommendation Title:

The CAA should consider initiating a SIP to investigate the occurrence rate of hidden-area fires and to investigate technical options for low-cost hidden-area fire detection.

Recommendation Scope: *(tick all that apply)*

Regulatory Change	☐	Guidance Material	☐	Training	☐	Further Study/Research	☒
Procedural Change	☐	Technology	☐	Other			

Addressee (e.g. CAA):	If CAA, then Proposed Recommendation Sponsor (CAA Business Area): ***(use drop-down list)***
CAA	Airworthiness

Justification:

Risk(s) to be Mitigated (both safety and business risks):

Hidden fires provide a significant safety risk to aircraft. Research has shown that if an in-flight fire becomes out of control, there is typically only 15 minutes before loss of control of the aircraft occurs.

Risk(s) of not Implementing (both safety and business risks):

If such an event occurs, the CAA could be criticised for complacency for not taking steps to address a significant potential safety concern.

Benefits:

Provide a report, which will consider the occurrences of hidden-area fires with options and cost benefits for sensing fires in hidden cabin areas.

Supporting Data:

The present technique of establishing the presence or position of a fire in a hidden area of the cabin is unsatisfactory, often relying on the cabin crew to establish 'hot spots' using the back of their hand on the cabin wall. This is an unreliable method of detecting a hidden fire because parts of the cabin wall are naturally warmer than others, depending on the interior arrangements (e.g. the presence of hot-air ducting).

Whilst the incorporation of fire detection and suppression systems throughout the hidden areas of the aircraft would be the preferred option, this is unlikely to be cost effective. This project would consider other options.

Task Force: *(use drop-down list)*

Airborne and Post-Crash Fire

Recommendation Reference (e.g. LoCTF01):

APCFTF 02

Recommendation Title:

The CAA should initiate a SIP to consider the feasibility and potential cost benefit of identifying differing smells, fumes and smoke in the cabin and secondly, to examine commercially available equipment to see if suitable equipment is likely to be operationally effective.

Recommendation Scope: *(tick all that apply)*

Regulatory Change	☐	Guidance Material	☐	Training	☐	Further Study/Research	☒
Procedural Change	☐	Technology	☐	Other			

Addressee (e.g. CAA):	If CAA, then Proposed Recommendation Sponsor (CAA Business Area): ***(use drop-down list)***
CAA	Airworthiness

Justification:

Risk(s) to be Mitigated (both safety and business risks):

The relatively high frequency of smoke/fire occurrences often leads to flights diverting or returning and some may have the potential to escalate into an uncontrollable fire, if the source was a hidden fire. This research work would consider means of indentifying smells and therefore possible causes and actions to be taken.

Risk(s) of not Implementing (both safety and business risks):

To continue to rely on the human sense of smell and operational procedures to react to smells and with no action to improve fume/smoke source identification, MORs will continue to occur with no improvement.

Benefits:

A report produced to identify possible solutions for smell identification would allow a more focused review of incidents to prevent re-occurrence and hence reduce the number of MORs / risk to aircraft and crew, and would also reduce operators' costs.

Supporting Data:

For in-flight fires, the human sense of smell is usually the first warning of a fire. This is an unregulated, ill-defined process subject to human olfactory sensitivity and group decision-making. It is likely to be more reliable to use a measurement system that can differentiate between common cabin air contaminants such as hydraulic, oil, anti-ice fumes, and fumes from a fire. This may provide earlier confirmation of a potential fire or provide greater information for fault isolation and prevention in the future. Such equipment is already available to maintenance engineers for ground servicing.

Task Force: *(use drop-down list)*

Airborne and Post-Crash Fire

Recommendation Reference (e.g. LoCTF01):

APCFTF03

Recommendation Title:

The CAA should initiate a SIP to review cabin fire-fighting equipment, define suitable tools for cabin panel removal that cannot be misused and investigate the introduction of fire ports that would allow the discharge of extinguishers to some hidden areas of the cabin.

Recommendation Scope: *(tick all that apply)*

Regulatory Change	☐	Guidance Material	☐	Training	☐	Further Study/Research	☒
Procedural Change	☐	Technology	☐	Other			

Addressee (e.g. CAA):	If CAA, then Proposed Recommendation Sponsor (CAA Business Area): ***(use drop-down list)***
CAA	Airworthiness

Justification:

Risk(s) to be Mitigated (both safety and business risks):

If crew suspect a hidden fire, they currently have limited means to gain access to the area concerned. An uncontrolled fire has shown to cause the loss of an aircraft in approximately 15 minutes.

Risk(s) of not Implementing (both safety and business risks):

If such an event occurs the CAA could be criticised for complacency for not taking steps to address a significant potential safety concern.

Benefits:

Produce a report containing a review of cabin fire-fighting equipment and develop the specification for a panel removal tool and guidelines for its use. Develop guidelines for when fire ports may be effective in cooperation with EASA action.

Supporting Data:

Cabin and flight deck fire-fighting equipment should be reviewed. This will complement the recent CAA study (*CAA Paper 2009/01*) on cabin crew fire training, in particular on how crew access hidden areas of the cabin. An alternative to the crash axe should be developed that cannot be misused as a weapon. In parallel, the provision of access ports in the cabin walls for the discharge of fire extinguishers should be revisited. Early work by the FAA has indicated practical problems but there is an opportunity to establish under which conditions (probably limited to low volume regions) they may be feasible for further development by EASA.

Task Force: *(use drop-down list)*

Airborne and Post-Crash

Recommendation Reference (e.g. LoCTF01):

APCFTF04

Recommendation Title:

The CAA should initiate a SIP to consider cabin crew communications in the event of fire.

Recommendation Scope: *(tick all that apply)*

Regulatory Change	☐	Guidance Material	☐	Training	☐	Further Study/Research	☒
Procedural Change	☐	Technology	☐	Other			

Addressee (e.g. CAA):	If CAA, then Proposed Recommendation Sponsor (CAA Business Area): ***(use drop-down list)***
CAA	Airworthiness

Justification:

Risk(s) to be Mitigated (both safety and business risks):

Poor communication within and between the cabin and flight deck in the event of smoke/fire events leading to ineffective fire-fighting and evacuation.

Risk(s) of not Implementing (both safety and business risks):

Failing to act to address a known issue would adversely affect the CAA's reputation.

Benefits:

A report setting out accident/incident experiences, a review of appropriate technology and consideration of operational needs.

Supporting Data:

The need for improved cabin crew communications was highlighted in *CAA Paper 2009/01* and was the subject of three AAIB recommendations. Additionally, as future cabin interiors become larger and more complex, existing direct verbal communication may no longer be practicable. Transport Canada have already instigated a project review this issue.

Task Force: *(use drop-down list)*

Airborne and Post-Crash Fire

Recommendation Reference (e.g. LoCTF01):

APCFTF05

Recommendation Title:

The CAA should initiate a SIP to review the latest understanding of the lightning environment.

Recommendation Scope: *(tick all that apply)*

Regulatory Change	☐	Guidance Material	☐	Training	☐	Further Study/Research	☒
Procedural Change	☐	Technology	☐	Other			

Addressee (e.g. CAA):	If CAA, then Proposed Recommendation Sponsor (CAA Business Area): ***(use drop-down list)***
CAA	Airworthiness

Justification:

Risk(s) to be Mitigated (both safety and business risks):

There is evidence that climate change will lead to an increase in lightning strikes causing fire or smoke events on aircraft.

Risk(s) of not Implementing (both safety and business risks):

Increased occurrences of lightning strikes in combination with composite aircraft is an emerging threat and may lead to an aircraft crash. Research may be able to either provide guidance or rule changes to aircraft design, to improve the airframe capability.

Benefits:

A report will be produced considering the lightning environment and any changes noted in atmospheric climate. The CAA can be seen to be proactive at addressing emerging issues.

Supporting Data:

Lightning-induced fires are rare but there are concerns that the aircraft lightning environment may not be appropriately characterised, which is particularly significant for composite aircraft although the B787 will have inerted fuel tanks that should reduce risks. In the North Sea helicopter environment the CAA is already active in this area. However, greater weather changes are anticipated as a result of global warming, with lightning implications. Whilst EASA may have the responsibility for regulatory action, a case needs to be made to consider the issue. The work will be carried out collaboratively with EASA through the European Aviation Research Partnership Group (EARPG). EARPG is an EASA-managed group for coordinating research activities in Europe.

Task Force: *(use drop-down list)*

Airborne and Post-Crash Fire

Recommendation Reference (e.g. LoCTF01):

APCFTF06

Recommendation Title:

The CAA should consider initiating a SIP to raise fire safety awareness through a campaign to Engineering and associated groups on the effect of fire/smoke events on aircraft caused by poor workmanship or inadequate quality control.

Recommendation Scope: *(tick all that apply)*

Regulatory Change ☐ Guidance Material ☐ Training ☐ Further Study/Research ☐

Procedural Change ☐ Technology ☐ Other **DVD / Support Training material**

Addressee (e.g. CAA):	If CAA, then Proposed Recommendation Sponsor (CAA Business Area): ***(use drop-down list)***
CAA	Airworthiness

Justification:

Risk(s) to be Mitigated (both safety and business risks):

Most fire/smoke events are caused by or propagated by careless workmanship, or lack of awareness of the potential outcome of a seemly minor issue which can cause a smoke or fire event.

Risk(s) of not Implementing (both safety and business risks):

This is a proactive recommendation to address the root cause of many fire/smoke events before they occur. If the CAA does not carry out this work there will not be a reduction in the incidence of smoke and fire events.

Benefits:

Provide a hard-hitting, long-lasting, cause and effect DVD presentation to be shown to Engineering groups and a selection of their suppliers on the importance of good quality practices. Consideration will then be given as to whether these practices should be included in continuation training.

Supporting Data:

Many of the fire and smoke events that the task force has reviewed could have been prevented by good practice. It is the task force's belief that if the effect of poor work standards or practices is demonstrated, then persons involved in the precursor events will be encouraged to improve their working practices in order to help prevent future smoke or fire incidents.

Task Force: *(use drop-down list)*

Airborne and Post-Crash Fire

Recommendation Reference (e.g. LoCTF01):

APCFTF07

Recommendation Title:

The CAA should consider initiating a SIP to raise fire safety awareness through a campaign to Flight Operations and associated groups on the effect of fire/smoke events on aircraft caused by inadequate quality control.

Recommendation Scope: *(tick all that apply)*

Regulatory Change	☐	Guidance Material	☐	Training	☐	Further Study/Research	☐
Procedural Change	☐	Technology	☐	Other	**DVD / Support training material**		

Addressee (e.g. CAA):	If CAA, then Proposed Recommendation Sponsor (CAA Business Area): ***(use drop-down list)***
CAA	Flight Operations

Justification:

Risk(s) to be Mitigated (both safety and business risks):

Most fire/smoke events are caused by or propagated by careless workmanship, or lack of awareness of the potential outcome of a seemly minor issue which can cause a smoke or fire event.

Risk(s) of not Implementing (both safety and business risks):

This is a proactive recommendation to address the root cause of many fire/smoke events before they occur. If the CAA does not carry out this work there will not be a reduction in the incidence of smoke and fire events.

Benefits:

Provide a hard-hitting, long-lasting, cause and effect DVD presentation to be shown to Flight Operations groups and a selection of their suppliers (e.g. caterers) on the importance of good quality control practices. Consideration will then be given as to whether these practices should be included in continuation training.

Supporting Data:

Many of the fire and smoke events that the task force has reviewed could have been prevented by good quality control practice. It is the task force's belief that if the effect of poor quality control practices is demonstrated, then persons involved in the precursor events (like inspection standards or a review of catering packaging) will be encouraged to improve their working practices in order to help prevent future smoke or fire incidents.

Task Force: *(use drop-down list)*

Airborne and Post-Crash Fire

Recommendation Reference (e.g. LoCTF01):

APCFTF08

Recommendation Title:

The CAA should consider initiating a SIP to produce guidance material for operators on the processes associated with aircraft oven servicing and the suitability of heated food procedures.

Recommendation Scope: *(tick all that apply)*

Regulatory Change	☐	Guidance Material	☒	Training	☐	Further Study/Research	☒
Procedural Change	☐	Technology	☐	Other			

Addressee (e.g. CAA):	If CAA, then Proposed Recommendation Sponsor (CAA Business Area): ***(use drop-down list)***
CAA	Flight Operations

Justification:

Risk(s) to be Mitigated (both safety and business risks):

To prevent smoke and fire events caused by careless processes associated with the provision of hot meals or snacks.

Risk(s) of not Implementing (both safety and business risks):

The high incidence of smoke and fire events from ovens will continue unabated with the potential of CAA reputational damage.

Benefits:

Provide guidance material on the commercial, catering interface and cleaning procedures to reduce the risk of smoke and fires in ovens.

Supporting Data:

Most aircraft fire/smoke events involve ovens; many are caused by poor cleaning, and packaging or labels (from the packaging) that end up on the meal trays. It is thought that the labelling, particularly for specific dietary requirements, can contribute to these issues. SMS should be used to identify and prevent hazards before they occur, and the quality system will ensure adherence to procedures and enable follow-up on quality lapses through the safety group within the airline.

Task Force: *(use drop-down list)*

Airborne and Post-Crash Fire

Recommendation Reference (e.g. LoCTF01):

APCFTF09

Recommendation Title:

The CAA should consider initiating a SIP to provide greater / focused sampling during Cabin Safety Flight and Ramp Inspections on servicing and in-flight oversight of toilet supplies and storage of the same.

Recommendation Scope: *(tick all that apply)*

Regulatory Change	☐	Guidance Material	☐	Training	☐	Further Study/Research	☐
Procedural Change	☐	Technology	☐	Other	**Focused oversight**		

Addressee (e.g. CAA):	If CAA, then Proposed Recommendation Sponsor (CAA Business Area): ***(use drop-down list)***
CAA	Flight Operations

Justification:

Risk(s) to be Mitigated (both safety and business risks):

To prevent smoke and fire events caused by the storage of paper products.

Risk(s) of not Implementing (both safety and business risks):

The potential for careless/opportunist storage of paper products to cause smoke/fire events and CAA reputational damage.

Benefits:

Cabin Safety Office to provide a report on industry's ability to control the storage of toilet supplies.

Supporting Data:

There have been a number of toilet fires caused by paper products having been stored adjacent to either the toilet heater or electrical light fittings and ballast units.

Task Force: *(use drop-down list)*

Airborne and Post-Crash Fire

Recommendation Reference (e.g. LoCTF01):

APCFTF10

Recommendation Title:

The CAA should consider initiating a SIP to collaborate with other interested parties in defining acceptable levels of contamination in hidden areas.

Recommendation Scope: *(tick all that apply)*

Regulatory Change	☐	Guidance Material	☐	Training	☐	Further Study/Research	☒
Procedural Change	☐	Technology	☐	Other			

Addressee (e.g. CAA):	If CAA, then Proposed Recommendation Sponsor (CAA Business Area): ***(use drop-down list)***
CAA	Airworthiness

Justification:

Risk(s) to be Mitigated (both safety and business risks):

Contamination in hidden areas can contribute significantly to the propagation of a fire, but the risks are not fully understood.

Risk(s) of not Implementing (both safety and business risks):

The build-up of contamination will continue to be left to individuals to determine what they believe to be acceptable levels, with the potential to cause the propagation of a fire in a hidden area. Failure to address this issue could cause significant damage to the CAA's reputation in the event of a hull loss where contamination was a contributing factor.

Benefits:

To draft specifications for review within the aviation community, including the International Aircraft Systems Fire Protection Working Group.

Supporting Data:

Hidden area dust, lint and debris pose a fire threat but no acceptable levels of cleanliness are specified. Similarly, the level of acceptable contamination on thermal acoustic insulation is not specified but influences flammability. It is proposed that potential standards are formulated in conjunction with the FAA Technical Center which has interests in this area.

Task Force: *(use drop-down list)*

Airborne and Post-Crash Fire

Recommendation Reference (e.g. LoCTF01):

APCFTF11

Recommendation Title:

The CAA should consider initiating a SIP to continue its support of the development of more effective fire-fighting foams.

Recommendation Scope: *(tick all that apply)*

Regulatory Change	☐	Guidance Material	☐	Training	☐	Further Study/Research	☒
Procedural Change	☐	Technology	☐	Other			

Addressee (e.g. CAA):	If CAA, then Proposed Recommendation Sponsor (CAA Business Area): ***(use drop-down list)***
CAA	Licensing and Training Standards

Justification:

Risk(s) to be Mitigated (both safety and business risks):

Failing to promote more effective foams which are crucial for post-crash fire-fighting.

Risk(s) of not Implementing (both safety and business risks):

The CAA could be criticised for compliancy. It is known that better fire-fighting foams exist but there is no CAA position on their use, which contributes to the risk.

Benefits:

New ICAO specifications for fire-fighting foams.

Supporting Data:

The CAA with Transport Canada funding and on behalf of the ICAO Rescue and Fire Fighting Sub-Group, have conducted tests on advanced fire-fighting foams and have developed potential new industry foam specifications. The work needs to be completed with larger-scale demonstrations and investigations on remaining improvements, such as compressed-air foams.

Task Force: *(use drop-down list)*

Airborne and Post-Crash Fire

Recommendation Reference (e.g. LoCTF01):

APCFTF12

Recommendation Title:

The CAA should consider initiating a SIP to provide continued involvement in international fire/smoke working groups to ensure that UK fire safety concerns are considered.

Recommendation Scope: *(tick all that apply)*

Regulatory Change	☐	Guidance Material	☐	Training	☐	Further Study/Research	☒
Procedural Change	☐	Technology	☐	Other			

Addressee (e.g. CAA):	If CAA, then Proposed Recommendation Sponsor (CAA Business Area): ***(use drop-down list)***
CAA	Group Safety Services

Justification:

Risk(s) to be Mitigated (both safety and business risks):

Safety Risk: the CAA would be in ignorance of activities and research being carried out worldwide and would therefore be unable to influence emerging issues.

Risk(s) of not Implementing (both safety and business risks):

The CAA will not be aware of world trends and initiatives which would put its reputation at risk.

Benefits:

Strategic Analysis will prepare a six-monthly update of research activities being undertaken by the CAA and the largest international working groups on fire/smoke initiatives. This will be reviewed and distributed by the task force.

Supporting Data:

The CAA has carried out a number of exercises on fire/smoke events over the years but there has been a danger that each initiative loses momentum after the initial recommendations are made. This recommendation is made to ensure that the CAA's accepted fire safety initiatives are tracked and reported on in a controlled manner. In addition to internal work, the CAA must keep abreast of and be involved in international working groups, if it wants to influence the work being carried out. By taking this holistic approach to fire safety, the CAA can endeavour to rationalise the work carried out so far and facilitate the implementation of constructive initiatives to enhance fire safety.

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Annex A Summary of Joint CAA-Industry 'Significant Seven' Task Forces

1 Introduction and Background

1.1 The CAA task force initiative was launched in June 2009 as an action from the 2009 Safety Conference to address the seven top safety risks identified by the CAA safety risk analysis process. This process is described in the CAA *Safety Plan 2009/11 (CAP 786)* and essentially combines analysis of worldwide fatal accidents carried out by the CAA Accident Analysis Group (AAG) with more detailed analysis of high-severity occurrences to UK aircraft carried out by The High Risk Events Analysis Team (THREAT).

1.2 Five new task forces were created: Airborne and Post-Crash Fire, Airborne Conflict, Runway Overrun or Excursion, Loss of Control and Controlled Flight into Terrain (CFIT). Existing working groups addressed the remaining two safety issues: the Runway Incursions Steering Group (RISG) covered Runway Incursion and Ground Collision, and the Ground Handling Operations Safety Team (GHOST) covered Ramp Incidents.

1.3 Significant work was already underway or complete for several of the task force subjects (e.g. loading issues progressed by GHOST, runway incursion issues covered by RISG and airspace safety issues covered by the Airspace and Safety Initiative). The task forces were explicitly asked not to duplicate work but to identify where any additional safety intervention was required and to endorse, where appropriate, the continuation of existing work streams.

1.4 A key feature of all task forces was the inclusion and active participation of the aviation industry (a list of all participating organisations can be found at Appendix 1).

1.5 The task forces reported their findings and recommendations at the end of May 2010. Their final reports have been combined into one publication, CAA *Paper 2011/03*, which can be downloaded from the CAA website. The output was consolidated and prioritised in an iterative process to identify: key desired outcomes, actions to achieve these outcomes, why these actions will make a difference, how success in achieving the outcomes can be measured and the corresponding safety performance indicators. The prioritised output was then shared with industry and actively debated at the Safety Conference in October 2010.

1.6 This paper summarises the key output from each of the task forces, taking into account feedback from the 2010 Safety Conference, and includes: actions to mitigate the identified risks, and measures to track future safety performance and effectiveness of the actions. These actions will contribute significantly to the next CAA Safety Plan, which is due to be published in 2011, and will be implemented in partnership with industry.

1.7 As well as identifying actions to mitigate the risk of specific outcomes, the task forces also identified several issues common to all outcomes, namely: the need to better understand human factors, and particularly their contribution to the root causes of accidents, the importance of a good organisational culture as a prerequisite for a good safety culture, and the need to join-up SMS across all aviation disciplines. The new Safety Plan will contain actions to address all of these systemic issues.

2 Task Force Results

2.1 Loss of Control Task Force

Advances in technology and automation that had mitigated the risk of other types of accident (e.g. CFIT) were found to have increased, or at least changed, the risk associated with loss of control. Currently, when training and testing pilot competence, the principal focus is on their handling skills rather than monitoring skills. However, safe operation of complex and highly automated aircraft relies on effective monitoring of aircraft systems, automation and the other pilot's actions.

2.1.1 Key Desired Outcomes

1. Significant reduction in the number of loss of control occurrences and serious incidents in which inadequate or ineffective monitoring by the flight crew was a contributory or causal factor.
2. Significant reduction in the number of loss of control occurrences and serious incidents in which inadequate or ineffective manual flying skills and/or use of aircraft automation by the flight crew was a contributory or causal factor.
3. Increase in the number of UK operators using Alternative Training and Qualification Programmes (ATQP).

2.1.2 Proposed Actions to Achieve Key Desired Outcomes

Action 1

a) Identify best practices in human flight deck monitoring and propose associated training methods through a working group of airline industry training specialists.

b) UK operators to prepare Pilot Monitoring Skills Training Plans based on the above and all pilots employed by UK AOC holders to receive training in accordance with these plans.

Action 2

a) UK operators and training providers to ensure that initial training syllabi properly equip all pilots with the necessary level of manual flying skills, and that recurrent training syllabi enable these skill levels to be maintained.

b) UK operators and training providers to review their current syllabi for the training of automation, and explore how the style and content of this training may be modified to equip crews to operate complex and highly automated aircraft more effectively. The outcome would be subject to audit under the Flight Operations Inspectorate operator oversight programme.

c) Engage with EASA to modify the Part FCL type-rating syllabus and pilot check requirements for highly-automated aircraft types so that there is more focus on the use of automation and, in particular, use of a level of automation appropriate to the specific task. In the UK it would be possible to monitor the effectiveness of such changes through the Flight Operations Inspectorate operator oversight programme.

Action 3

a) EASA in its regulatory role, and the CAA and other European National Aviation Authorities in their interpretation and implementation, to introduce a process whereby medium- and small-sized operators are able to adopt ATQP.

b) For the purposes of implementation, CAA to make provision for smaller operators to:

i) combine their task analyses for the definition of curricula, and make use of operators' collective data, data provided by the aircraft manufacturer and, where applicable, third-party training provider;

ii) combine their feedback loops to validate the content of the curricula; and

iii) use common methodologies for assessment of flight crew during conversion and recurrent training and checking.

c) Engage with EASA to facilitate the adoption of ATQP by mixed-fleet flying operators.

2.1.3 **Why Proposed Actions Will Make a Difference**

Action 1

Currently, in some multi-crew loss of control events, the monitoring pilot is failing to prevent the loss of control by the pilot flying. An increased focus on the monitoring role within a multi-crew flight deck could be expected to improve the likelihood of the avoidance and recognition of potential loss of control events.

Action 2

A modified methodology for the training of automation in complex and highly automated aircraft would better equip pilots to identify and avoid loss of control situations, whilst possession and currency in the key manual flying skills would enable them to recover from such scenarios.

Action 3

ATQP has been unanimously hailed a great success by the UK airlines that have adopted it. It has been welcomed for its effectiveness by trainers and line crews alike, and has produced a measurable improvement in operating standards.

2.1.4 **Measures of Success**

Reduction in the number of genuine stall warnings (including stick-shakes or alpha floor events), undetected auto-throttle drop-outs, excessive speed and flight path excursions and configuration warnings.

2.1.5 **Proposed Safety Performance Indicators**

- Loss of control related occurrences (broken down by severity and cause: either due to technical failure, non-technical failure or environmental factors).
- Precursors to the above (note: some of these rely on FDM-based data):
  - stick-shakes and alpha floor events;
  - excessively low/high speed during flight;
  - excessive pitch/bank attitude during flight;
  - excessive in-flight normal acceleration (indicator of severe turbulence);
  - take-off configuration warnings;
  - simultaneous side-stick use;
  - undetected auto-throttle drop-out; and
  - inappropriate auto-pilot mode for given stage of flight.

2.1.6 **Proposed Measures of Risk Exposure**

- Pilot response time (e.g. to cockpit warnings).

2.1.7 Other Actions Proposed by the Task Force

The following actions were also proposed but were deemed to have a lower priority compared to other actions developed by this and other task forces. Industry feedback received at the Safety Conference also did not suggest that their priority should be raised.

- Change the content of the JAR-FCL Licence Skills Test (LST) by making it type specific for modern highly automated aeroplanes.
- Enhance Multi-Crew Pilot Licence (MPL) requirements.
- Mandate (1) upset recovery training for all pilots, and (2) a requirement for data at the edges of the aircraft's flight envelope (for example in the stall regime, where a wing may drop) to be incorporated in full flight simulators to facilitate such training.
- Mandate that pilots (other than holders of a MPL) complete a Jet Orientation Course prior to commencement of their first type-rating course on a highly automated jet aeroplane.

2.2 Runway Overrun or Excursion Task Force

The task force considered that landing within the touchdown zone in the correct configuration and at the correct speed, and if this could not be ensured then flying a go-around, were the key factors in avoiding a runway overrun or excursion. Other factors that increased the risk included provision of incomplete runway contamination data to pilots, failure to provide compliant runway surface friction characteristics and inadequacy of safety areas surrounding the runway.

2.2.1 Key Desired Outcomes

1. Reduce the number of unstable/de-stabilised approaches, and particularly those that continue to a landing.
2. Introduce capability for aerodrome operators to provide meaningful data to pilots on runway friction and contamination.

2.2.2 Proposed Actions to Achieve Key Desired Outcomes

Action 1

a) Produce generic best practice guidance material regarding unstable/de-stabilised approach and associated go-around requirements, and promote and monitor through RETRE.

b) Produce generic best practice guidance material regarding precursors to runway excursions, identified through operator FDM programmes, and promote and monitor.

c) Operators set and monitor runway excursion precursor measures and, where appropriate, implement relevant training exercises through ATQP, LOFT, etc.

d) Revise air traffic procedures to eliminate/reduce controller-induced unstable approaches, and revise air traffic controller training to emphasise the need for a stabilised approach.

Action 2

Support and influence efforts to standardise International and European (EASA) standards associated with both runway friction and aircraft performance so that accurate, unambiguous and easy to use information is passed to flight crew to allow an accurate assessment of the take-off or landing distance required.

2.2.3 Why Proposed Actions Will Make a Difference

Action 1

Reduction in the number of unstable/de-stabilised approaches that continue to a landing will reduce the risk of aircraft touching down at the incorrect speed and/or position with a corresponding reduction in the risk of running off the side or end of the runway.

Action 2

Flight crews will be better equipped to accurately anticipate the braking action required on contaminated runways.

2.2.4 Measures of Success

- Reduction in the number of all unstable/de-stabilised approaches and those that continue to a landing, without a corresponding increase in the number of incorrectly flown go-arounds.
- Reduction in the number of deep landings and an increase in the number of touchdowns in the runway Touch-Down Zone at the correct speed.
- Reduction in the number of overruns/excursions with runway contamination as a contributory or causal factor.

2.2.5 Proposed Safety Performance Indicators

- Runway excursions/overruns by UK aircraft worldwide (broken down by severity).
- Runway excursions/overruns at UK aerodromes (broken down by severity).
- Precursors to the above:
  - take-off/landing events involving aquaplaning and crosswinds;
  - landing events involving tailwinds, flare problems and hard landings; and
  - rejected take-offs.

  The following rely on FDM-based data:
  - all unstable/de-stabilised approaches;
  - unstable/de-stabilised approaches that continue to land;
  - deep/fast/bounced landings;
  - significant tailwind during take-off/landing;
  - Significant heading deviation during take-off/landing;
  - slow acceleration during take-off and slow deceleration during landing; and
  - brakes on during take-off/landing.

2.2.6 Proposed Measures of Risk Exposure

- proportion of tailwind take-off and landings flown by UK aircraft;
- proportion of Cat C aerodromes visited by UK aircraft.

2.3 Controlled Flight Into Terrain (CFIT) Task Force

CFIT risk was found to be greatest during non-precision approaches and the most common causes were: descent below decision/safety heights without appropriate visual reference, inadequate monitoring and lack of positional awareness. Terrain Awareness and Warning System (TAWS) warnings were an effective mitigation but relied on correct flight crew response, up-to-date terrain databases and software, and the most accurate source of position information feeding into them.

2.3.1 **Key Desired Outcome**

- Significant reduction in the number of serious incidents that occur during non-precision approaches (NPAs), through enhancements in technology and training.

2.3.2 **Proposed Actions to Achieve Key Desired Outcome**

Action 1

Run an education campaign aimed at operators, highlighting the safety and cost benefits of Approach with Vertical Guidance (APV) type approaches.

Action 2

Investigate implementation of APV-type approaches in the USA to identify factors that could help accelerate implementation in UK and the rest of Europe and feed this back to the ongoing European work in this area.

Action 3

Simplify the process for operators to become APV approved.

Action 4

Encourage operators to become APV approved and aerodrome operators to make appropriate provisions.

2.3.3 **Why Proposed Actions Will Make a Difference**

- Reduction in the high proportion of CFIT incidents/accidents that occur during NPAs.

2.3.4 **Measures of Success**

- Reduction in the number of serious incidents that occur during NPAs (e.g. TAWS warnings).
- Reduction in the number of traditional NPAs published in the UK AIP with a corresponding increase in APV-type approaches.
- Increase in the number of APV-type approaches at EU and non-EU aerodromes, which are UK operator destinations.

2.3.5 **Proposed Safety Performance Indicators**

- TAWS warnings (broken down by severity, TAWS mode, phase of flight and location).
- Precursors to the above (note: these all rely on FDM-based data):
  - all TAWS warnings;
  - incorrect response to TAWS;
  - significant deviation below the glideslope and/or about the localiser;
  - excessively low during the approach;
  - unstable approaches at or prior to 500 ft that continue to land; and
  - unstable approaches that become unstable after 500 ft, and either continue to land or a go-around is flown.

2.3.6 **Proposed Measures of Risk Exposure**

- proportion of UK aircraft not equipped with TAWS;
- proportion of UK aircraft equipped with TAWS that does not have a direct feed of GPS position;

- proportion of UK aircraft flights that dispatch with unserviceable TAWS;
- proportion of non-precision approaches flown by UK aircraft;
- proportion of aerodromes visited by UK aircraft that do not have a precision navigation approach aid or GNSS-based approach;
- proportion of UK commercial air transport (CAT) aerodromes that do not have a precision navigation approach aid or GNSS-based approach;
- proportion of aerodromes visited by UK aircraft that are not equipped with Minimum Safe Altitude Warning (MSAW) systems; and
- proportion of UK CAT aerodromes that are not equipped with MSAW.

2.3.7 Other Actions Proposed by the Task Force

The following actions were also proposed but were deemed to have a lower priority compared to other actions developed by this and other task forces. Industry feedback received at the Safety Conference also did not suggest that their priority should be raised.

- Carry out a cost/benefit analysis of deploying MSAW systems at appropriate UK aerodromes.
- Carry out a cost/benefit analysis and feasibility study for requiring TAWS databases to be certified (including a requirement for regular updates) and for requiring a direct feed of GNSS-based aircraft position data into TAWS.
- Review the philosophy in allowing operators to dispatch with inoperative TAWS equipment for up to 10 days.
- Encourage UK operators to consider including circling approach training in their recurrent checks. It is also recommended that operators should be encouraged to provide detailed procedures for aerodromes that have significant obstacles in the circling area or special requirements when circling.
- Carry out further analysis of downloaded Mode S data to determine the incidence of altimeter subscale mis-setting.
- Review the implementation of TAWS for UK public transport helicopter operations.

2.4 Runway Incursions Steering Group (RISG)

The RISG is a mature group that has been able to build an excellent working relationship with industry and stakeholders by working closely together. Continued engagement with industry will help to see a reduction in the number of runway incursions by UK-registered aircraft, by ground vehicles and at UK aerodromes. An example of this is the recent change in the CAA's position regarding the publication of runway hotspots in the AIP, in which advice from and investigation with industry suggested benefits from greater awareness by flight crews.

2.4.1 Key Desired Outcome

- Zero Category A incidents, a reduction in Category B incidents and a significant reduction in Category C and D incidents.

2.4.2 Proposed Actions to Achieve Key Desired Outcome

Action 1

Engage with industry and other stakeholders to provide a 'joined-up' approach to resolving runway incursion issues in a collaborative fashion. As part of the engagement process, CAA to facilitate in areas such as runway safety, and ensuring that where appropriate, relevant AAIB recommendations are followed-up by industry.

Action 2

Audit and support all UK-licensed aerodromes to ensure that, where appropriate, a Local Runway Safety Team (LRST) is in place and is effective.

Action 3

Audit and Support aerodrome operators to, through their LRSTs, review, identify and address infrastructure and communication issues such as taxi patterns, signage and complex RT procedures; and that they develop appropriate mitigations where appropriate (for example, the publication of runway hotspots).

2.4.3 **Why Proposed Actions Will Make a Difference**

Action 1

Will enable both parties to gain a better understanding of the issues that affect each other, and this will enable a partnership approach to robust resolution of the issues.

Action 2

Will ensure that LRSTs are providing meaningful and useful output.

Action 3

These are key factors in runway incursions, and will help to reduce the number of incidents.

2.4.4 **Measures of Success**

- A reduction in the number of runway incursions.

2.4.5 **Proposed Safety Performance Indicators**

- runway incursions at UK aerodromes (broken down by severity, aerodrome size (based on traffic), location, infringing entity, causal factors, causal entity and incursion type); and
- runway incursions at foreign aerodromes.

2.4.6 **Proposed Measures of Risk Exposure**

- proportion of UK aerodromes not equipped with Surface Movement Radar and associated safety net (e.g. RIMCAS);
- proportion of UK aerodromes that do not operate lit stop bars 24 hours per day;
- proportion of UK licensed aerodromes with a LRST; and
- proportion of UK licensed aerodromes with a LRST that have been audited.

2.4.7 **Other Actions Proposed by RISG**

The following actions were also proposed but were deemed to have a lower priority compared to other actions developed by this and other task forces. Industry feedback received at the Safety Conference also did not suggest that their priority should be raised.

- Share all relevant information more widely – if this involves commercially sensitive, but safety related information, then this should at least be shared on a de-identified basis with our RISG partners.
- Develop the Runway Safety page on the CAA website to highlight and share best practice regarding Runway Incursion Prevention including LRST information.
- Carry out research into the Human Factors elements that can lead to runway incursions.

- Review and promote the development of technological aids that prevent runway incursions, for example, runway status lights, RIMCAS and on-board equipment.

2.5 Airborne Conflict Task Force

The task force found that the greatest risk of airborne conflict existed outside of UK airspace (70% of the 27 high-severity airborne conflict related MORs between 2005 and 2008 occurred abroad), and the most effective barrier in resolving conflicts was the correct following of ACAS Resolution Advisories (RAs). However, it was felt that the CAA was unable to react effectively to the high number and severity of airborne conflict incidents outside of UK airspace due to a lack of information provided by the foreign States responsible for their investigation. A further challenge was managing the foreign and diplomatic sensitivities involved. EUROCONTROL data also suggested that a significant proportion of ACAS RAs were not responded to correctly, which supported the need for a review of the effectiveness of flight crew training in this area.

2.5.1 Key Desired Outcomes

1. Significant reduction in the number of overseas airborne conflict events involving UK registered/operated aircraft.
2. Significant improvement in response to ACAS RAs by flight crew of UK registered/ operated aircraft.
3. Significant reduction in the number of airborne conflict events in UK airspace.

2.5.2 Proposed Actions to Achieve Key Desired Outcome

Action 1

a) Submit the evidence of the significant number of airborne conflict events taking place outside of UK airspace to the DfT and seek advice on measures it would view as being politic and practical to raise the visibility of those particular areas outside of UK airspace where there is a high risk of airborne conflict.

b) Support the work of the ICAO group developing the use of Advanced Strategic Offset Concept (ASOC) and add some sense of urgency to it.

c) Fully support the proposal to ICAO to improve existing Strategic Lateral Offset Procedures (SLOP) by introducing Offset Allocation by Flight Level.

Action 2

a) Clarify and confirm the definitive source of guidance for ACAS training and amend ICAO *Doc 8168, Aircraft Operations* to cover ACAS training adequately.

b) Sample the quality of ACAS simulator training (including computer-based systems), establish the range of capabilities of devices to simulate realistic ACAS event scenarios and ensure that operators are aware of the potential of each simulator in this regard.

c) Review the EUROCONTROL data on the quality of pilot responses to ACAS events and take appropriate follow-up action to ensure appropriate and timely crew responses to ACAS events.

Action 3

The Airspace and Safety Initiative (ASI) Airborne ACAS Working Group to source information on MEL alleviation decisions in order that a subsequent recommendation be considered, for submission to EASA, to review the Rectification Intervals that are applied to ACAS equipment and achieve standardisation across Europe.

2.5.3 Why Proposed Actions Will Make a Difference

Action 1

a) Reduction in probability of airborne conflict events occurring.

b) Reduction in risk of collision following any vertical error on a one- or two-way airway.

c) Reduction in risk of collision or serious vortex encounter on oceanic track systems.

Action 2

Reduced risk of collision resulting from incorrect use of ACAS and enhancement of final barrier to mid-air collision, other than providence.

Action 3

Enhanced coverage of ACAS as a barrier to resolve conflicts.

2.5.4 Measures of Success

- Reduction in the number of losses of separation and ACAS events involving UK commercial air transport aircraft inside and outside of UK airspace.
- Effective resolution of loss of separation events when they do occur.

2.5.5 Proposed Safety Performance Indicators

- Loss of separation in UK controlled airspace (broken down by airspace type and aircraft size).
- AIRPROX in UK uncontrolled airspace (broken down by UK AIRPROX Board risk grade).
- All airborne conflict related events outside of UK airspace involving UK aircraft (broken down by the safety barrier that resolved the conflict).
- Precursors to the above:
  - level busts;
  - airspace infringements;
  - altimeter setting errors;
  - ACAS RAs; and
  - incorrect response to ACAS RAs (requires analysis of FDM data).

2.5.6 Proposed Measures of Risk Exposure

- proportion of UK aircraft not equipped with ACAS; and
- proportion of UK aircraft flights that dispatch with unserviceable ACAS.

2.5.7 Other Actions Proposed by the Task Force

The following action was also proposed but was deemed to have a lower priority compared to other actions developed by this and other task forces. Industry feedback received at the Safety Conference also did not suggest that its priority should be raised.

- Undertake a Europe-wide review of AIRPROX investigative and assessment organisations currently established by foreign states to support a proposal to the European Commission supporting the formation of an organisation, similar to the UK AIRPROX Board, to examine in detail airborne conflict events in European Airspace.

2.6 Ground Handling Operations Safety Team (GHOST)

The GHOST is mature group whose aim is to work with the UK aviation industry, organisations and groups worldwide to develop strategies to mitigate the safety risks from ground handling and ground support activities in the UK and elsewhere. MORs classified under the Ground Handling (GH) banner are numerous and very varied. The majority are classified as low risk. However, those with the potential to cause the biggest risk to aircraft safety (considering frequency and potential outcome) are loading errors and serious collisions between vehicles and aircraft, undetected prior to flight. Ramp-related MORs currently account for between 7% and 10% of all MORs.

2.6.1 Key Desired Outcomes

- Significant reduction in loading errors.
- Significant reduction in ground handling incidents caused by vehicles.

2.6.2 Root Causes

It is difficult to identify many common root causes for the wide variety of ground handling MORs. However, a lack of standardised procedures for loading and ground handling and a lack of competency[1] requirements for ground handling staff, across the UK, Europe and worldwide are common factors.

2.6.3 Proposed Actions to Achieve Key Desired Outcomes

There are two ways of addressing the lack of standardisation and competence within the industry:

Action 1

Voluntary adoption of standardised guidance material by the industry, accompanied by a self-monitoring programme.

Action 2

Increased regulation and regulatory oversight.

The GHOST is currently working on, or has completed the following:

Action 1: Voluntary Adoption of guidance material, accompanied by a self-monitoring programme

- Development of syllabi for initial and recurrent ground handling training that could be adopted by Ground Handling Organisations (GHOs), which has been endorsed by ECAST. *Completed. Measure of uptake of the guidance as yet unclear.*
- Development of loading error education material for promulgation to GHOs and airlines. *Winter 2010.*
- Production of a draft training framework and guidance material for drivers on the apron, which has been developed in cooperation with the AOA. *Consultation Autumn 2010, publication early 2011.*
- Internationally the IATA ISAGO programme aims to introduce an industry-auditing system of ground handing providers. The CAA has been an active participant in the working groups and we are monitoring the success of the programme.
- Explore the human factors aspects of ground handling safety in depth as many other areas within the industry have experienced step-changes in safety improvements after adoption of human factors principles.

1. A competent person is someone who has sufficient training and experience or knowledge and other qualities that allow them to complete their job safely.

2.6.4 **Why Proposed Actions Will Make a Difference**

- Increased awareness and competence leading to a reduction in human factors-related errors.
- Increased industry cooperation and shared ownership of risks.
- Increased internal monitoring, supervision and auditing to monitor and correct unsafe behaviours.

2.6.5 **Measures of Success**

- Reduction in the number of loading errors reported by UK AOC holders. However, in the short term the additional awareness raised by FODCOM 20/2010 and later the DVD may cause an increase in MORs – this is to be welcomed.
- Reduction in the number of collisions between vehicles and parked aircraft at UK aerodromes. It may be possible to determine an SPI for those aerodromes that have implemented in full the new driver training scheme recommendations and another for all other aerodromes. A positive effect would hopefully encourage the other aerodromes to take up the scheme.

Action 2: Increased regulation and regulatory oversight

- The CAA is reviewing internal auditing standards as well as airline and aerodrome oversight of third parties to determine whether enhanced or direct oversight of UK ground handling activities is necessary to significantly reduce GH incidents, and if so, how best it might be achieved; the CAA will act on the outcome. *End 2011.*
- A GHOST sub-group has drafted minimum competency requirements for drivers on the manoeuvring area and runways. *Consultation Autumn 2010, publication early 2011.*
- The CAA to encourage EASA SMS provisions to include oversight of third parties. *Within EASA timescales.*

2.6.6 **Why Proposed Actions Will Make a Difference**

- Safety standard will be reflected in ground handling contracts.
- Increased supervision and oversight to monitor and correct unsafe behaviours.
- Decreased runway incursions by vehicles.

2.6.7 **Measures of Success**

- Decreased number of loading errors and of ground handling incidents caused by vehicles.
- Decreased runway incursions by vehicles.

2.6.8 **Proposed Safety Performance Indicators**

- ramp occurrences (broken down by process during which they occurred, e.g. push-back, their outcome, e.g. loading error, and by reporter, e.g. airline or GHO);
- collisions involving vehicles and parked aircraft at UK reporting aerodromes;
- collisions, near-collisions and conflicts involving vehicles and taxiing aircraft at UK reporting aerodromes;
- number of vehicle-to-vehicle incidents; and
- damage caused by vehicles to infrastructure/equipment.

2.6.9 **Proposed Measures of Risk Exposure**

- loading errors resolved before doors closed;
- late aircraft type changes;
- number of late turn-arounds or turn-arounds in less than the minimum scheduled time; and
- exposure to de-icing.

2.7 **Airborne and Post-Crash Fire Task Force**

The majority of aircraft fire incidents analysed by the task force occurred in galleys, passenger and toilet areas but these were determined to be relatively low risk and unlikely to progress to a catastrophic accident. However, hidden area fires, although relatively infrequent, have a far greater potential for a catastrophic outcome. Most of the aircraft fires associated with fatal accidents occurred during the post-crash sequence and it would be more effective to address the causes of crashes (e.g. runway overruns or excursions) rather than make aircraft more tolerant to post-crash fire.

2.7.1 **Key Desired Outcome**

- Reduce the risk of hidden area fires occurring.

2.7.2 **Proposed Action to Achieve Key Desired Outcome**

- Raise fire safety awareness through a DVD/Internet training campaign to engineering and associated groups on the effects of fire/smoke events on aircraft caused by poor quality workmanship/control.

2.7.3 **Why Proposed Action Will Make a Difference**

- Improved workmanship will reduce the likelihood of poor maintenance practices causing hidden fires.

2.7.4 **Measures of Success**

- Promotion of good working practices should raise the awareness of poor workmanship, which may cause an increase of maintenance reported incidents in the short term but should provide a long-term decline in maintenance related incidents.
- Number of viewings of Internet training material.

2.7.5 **Proposed Safety Performance Indicators**

- Aircraft fires (broken down by severity, phase of flight and cause).
- Precursors to the above:
  - smoke occurrences (broken down by severity, phase of flight and cause);
  - fume occurrences (broken down by severity, phase of flight and cause); and
  - excessive brake temperatures during take-off (including rejected take-offs)/ landing (requires FDM-based data).

2.7.6 **Other Actions Proposed by the Task Force**

The following actions were also proposed but were deemed to have a lower priority compared to other actions developed by this and other task forces. Industry feedback received at the Safety Conference also did not suggest that their priority should be raised.

- Investigate the occurrence rate and cause of hidden area fires.

- Investigate options for low cost hidden area fire detection.
- Investigate the effectiveness of ports that may allow the discharge of fire extinguishers into some hidden areas.
- Review cabin fire-fighting equipment and define suitable tools for cabin panel removal that cannot be misused.
- Carry out a study on the feasibility and potential cost benefit of identifying differing smells, fumes and smoke in the cabin, whose source may be from a hidden area.
- Review commercially available equipment to see if suitable sensing equipment is likely to be operationally effective in identifying differing sources of fumes.
- Collaborate with other interested parties in defining acceptable levels of contamination in hidden areas.
- Development of a UK CAA Fire Safety Web page showing the work being carried out in support of fire safety initiatives, with reports, training and guidance material available to industry.

Appendix 1 External Organisations Participating in Task Forces

	Airborne Conflict	Airborne and Post Crash Fire	CFIT	Loss of Control	Ramp Incidents [GHOST]	Runway Excursion	Runway Incursion and Ground Collision [RISG]
AAIB				X			
Aircraft Service International Group					X		
Aviance UK					X		
BAA					X		X
BBA Aviation					X		
Bristol Airport						X	
British Airways		X	X		X	X	X
British Midland International					X		
CHC Scotia			X				
DCA International					X		
DHL					X		
East Midlands Airport					X		
EasyJet		X	X		X		X
Flybe		X			X		
GAPAN	X		X			X	
Health and Safety Executive					X		
Honeywell			X				
Human Engineering					X		
London Heathrow Airport						X	
London Luton Airport					X		X
Manchester Airport					X	X	X
Menzies Aviation					X		
MK Airlines					X		
MOD				X			X
MyTravel					X		
NATS	X		X			X	X
NetJets						X	
Plane Handling					X		
RAF				X			
Servisair					X		
Swissport UK					X		
TAG Aviation		X	X				
Thomas Cook Airlines		X		X			
Thomson Airways				X			
UK AIRPROX Board	X						
UK Flight Safety Committee				X	X		X
Virgin Atlantic Airways					X	X	X

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