

Safety Regulation Group



CAA PAPER 2009/01

Cabin Crew Fire Training

www.caa.co.uk

CAA Paper 2009/01

Cabin Crew Fire Training

Training Needs Analysis

Prepared for CAA by RGW Cherry and Associates Ltd

AUTHORS

Saryani Asmayawati

Nicholas Butcher

Ray Cherry

CONTRIBUTORS

Helen Tsai

Tom Mason

Sue Knight

Terry King

© Civil Aviation Authority 2009

All rights reserved. Copies of this publication may be reproduced for personal use, or for use within a company or organisation, but may not otherwise be reproduced for publication.

To use or reference CAA publications for any other purpose, for example within training material for students, please contact the CAA at the address below for formal agreement.

ISBN 978 0 11792 215 0

Published April 2009

Enquiries regarding the content of this publication should be addressed to:
Research and Strategic Analysis Department, Safety Regulation Group, Civil Aviation Authority, Aviation House, Gatwick Airport South, West Sussex, RH6 0YR.

The latest version of this document is available in electronic format at www.caa.co.uk, where you may also register for e-mail notification of amendments.

Published by TSO (The Stationery Office) on behalf of the UK Civil Aviation Authority.

Printed copy available from:

TSO, PO Box 29, Norwich NR3 1GN
Telephone orders/General enquiries: 0870 600 5522
Fax orders: 0870 600 5533

www.tso.co.uk/bookshop
E-mail: book.orders@tso.co.uk
Textphone: 0870 240 3701

List of Pages

Part	Page	Date	Part	Page	Date
	iii	April 2009		33	April 2009
	iv	April 2009		34	April 2009
	v	April 2009		35	April 2009
Contents	1	April 2009		36	April 2009
Foreword	1	April 2009		37	April 2009
List of Figures and Tables	1	April 2009		38	April 2009
List of Figures and Tables	2	April 2009		39	April 2009
List of Figures and Tables	3	April 2009		40	April 2009
Acknowledgements	1	April 2009		41	April 2009
Executive Summary	1	April 2009		42	April 2009
Executive Summary	2	April 2009		43	April 2009
References	1	April 2009		44	April 2009
Glossary	1	April 2009		45	April 2009
Glossary	2	April 2009		46	April 2009
	1	April 2009		47	April 2009
	2	April 2009		48	April 2009
	3	April 2009		49	April 2009
	4	April 2009		50	April 2009
	5	April 2009		51	April 2009
	6	April 2009		52	April 2009
	7	April 2009		53	April 2009
	8	April 2009		54	April 2009
	9	April 2009		55	April 2009
	10	April 2009		56	April 2009
	11	April 2009		57	April 2009
	12	April 2009		58	April 2009
	13	April 2009		59	April 2009
	14	April 2009		60	April 2009
	15	April 2009		61	April 2009
	16	April 2009		62	April 2009
	17	April 2009		63	April 2009
	18	April 2009		64	April 2009
	19	April 2009		65	April 2009
	20	April 2009		66	April 2009
	21	April 2009		67	April 2009
	22	April 2009		68	April 2009
	23	April 2009		69	April 2009
	24	April 2009		70	April 2009
	25	April 2009		71	April 2009
	26	April 2009		72	April 2009
	27	April 2009		73	April 2009
	28	April 2009		74	April 2009
	29	April 2009		75	April 2009
	30	April 2009		76	April 2009
	31	April 2009		77	April 2009
	32	April 2009		78	April 2009

Part	Page	Date	Part	Page	Date
	79	April 2009		127	April 2009
	80	April 2009		128	April 2009
	81	April 2009		129	April 2009
	82	April 2009		130	April 2009
	83	April 2009		131	April 2009
	84	April 2009		132	April 2009
	85	April 2009		133	April 2009
	86	April 2009		134	April 2009
	87	April 2009		135	April 2009
	88	April 2009		136	April 2009
	89	April 2009		137	April 2009
	90	April 2009		138	April 2009
	91	April 2009		139	April 2009
	92	April 2009		140	April 2009
	93	April 2009		141	April 2009
	94	April 2009		142	April 2009
	95	April 2009		143	April 2009
	96	April 2009		144	April 2009
	97	April 2009		145	April 2009
	98	April 2009		146	April 2009
	99	April 2009		147	April 2009
	100	April 2009		148	April 2009
	101	April 2009		149	April 2009
	102	April 2009		150	April 2009
	103	April 2009		151	April 2009
	104	April 2009		152	April 2009
	105	April 2009		153	April 2009
	106	April 2009		154	April 2009
	107	April 2009		155	April 2009
	108	April 2009		156	April 2009
	109	April 2009		157	April 2009
	110	April 2009		158	April 2009
	111	April 2009		159	April 2009
	112	April 2009		160	April 2009
	113	April 2009		161	April 2009
	114	April 2009		162	April 2009
	115	April 2009		163	April 2009
	116	April 2009		164	April 2009
	117	April 2009		165	April 2009
	118	April 2009		166	April 2009
	119	April 2009		167	April 2009
	120	April 2009		168	April 2009
	121	April 2009		169	April 2009
	122	April 2009		170	April 2009
	123	April 2009		171	April 2009
	124	April 2009		172	April 2009
	125	April 2009		173	April 2009
	126	April 2009		174	April 2009

Part	Page	Date	Part	Page	Date
	175	April 2009	Appendix 3	2	April 2009
	176	April 2009	Appendix 3	3	April 2009
	177	April 2009	Appendix 3	4	April 2009
	178	April 2009	Appendix 3	5	April 2009
	179	April 2009	Appendix 3	6	April 2009
	180	April 2009	Appendix 3	7	April 2009
	181	April 2009	Appendix 3	8	April 2009
	182	April 2009	Appendix 3	9	April 2009
	183	April 2009	Appendix 3	10	April 2009
	184	April 2009	Appendix 3	11	April 2009
	185	April 2009	Appendix 3	12	April 2009
	186	April 2009	Appendix 3	13	April 2009
	187	April 2009	Appendix 3	14	April 2009
	188	April 2009	Appendix 3	15	April 2009
	189	April 2009	Appendix 3	16	April 2009
	190	April 2009	Appendix 3	17	April 2009
	191	April 2009	Appendix 3	18	April 2009
	192	April 2009	Appendix 3	19	April 2009
	193	April 2009	Appendix 3	20	April 2009
	194	April 2009	Appendix 3	21	April 2009
	195	April 2009			
	196	April 2009			
	197	April 2009			
	198	April 2009			
	199	April 2009			
	200	April 2009			
	201	April 2009			
	202	April 2009			
	203	April 2009			
	204	April 2009			
	205	April 2009			
	206	April 2009			
	207	April 2009			
	208	April 2009			
	209	April 2009			
	210	April 2009			
	211	April 2009			
	212	April 2009			
	213	April 2009			
Appendix 1	1	April 2009			
Appendix 1	2	April 2009			
Appendix 1	3	April 2009			
Appendix 1	4	April 2009			
Appendix 1	5	April 2009			
Appendix 2	1	April 2009			
Appendix 2	2	April 2009			
Appendix 2	3	April 2009			
Appendix 3	1	April 2009			

INTENTIONALLY LEFT BLANK

Contents

Acknowledgements

Executive Summary

References

Glossary

Introduction	1
Review of Cabin Crew Fire Training Programmes	4
Online Cabin Crew Fire Training Survey	19
Fire Protection Training in Non-Civil Aviation Environments	65
Identification of Cabin Fire Threats	83
Identification of Issues and Related Potential Improvements to Cabin Crew Training	108
Methodology for Evaluating the Identified Potential Improvements to Cabin Crew Fire Training	117
Evaluation of Identified Potential Improvements to Cabin Crew Fire Training	119
Discussion and Conclusions	212

Appendix 1 Survey Form

Appendix 2 Fire/Smoke Occurrence Severity

Appendix 3 Relevant Accidents, Incidents and Recommendations

INTENTIONALLY LEFT BLANK

Foreword

This independent report was commissioned by the UK Civil Aviation Authority to review the current and future fire training needs of cabin crew. As aircraft operations change to meet evolving industry and passenger demands it is essential to ensure that a continued high level of safety is maintained. The UK Civil Aviation Authority will work with the European Aviation Safety Agency where appropriate to develop European-wide safety rules and with UK operators to ensure that the best fire training advice is available.

Safety Management Systems, as an integral part of the effective control of risks in aviation operations, include cabin crew fire training needs within wider training requirements. The UK CAA will continue to support rigorous threat evaluation particularly in the definition and management of low probability, high severity events such as in-flight fires.

The UK CAA conducts oversight of operators by way of annual audit and various inspections. Training Manuals and associated syllabi are approved by the UK CAA and sample inspections may be conducted on both documentation and actual training sessions. During such audits, further inspection is made of the operator's Quality System to ensure that this includes a process to ensure monitoring and sampling to ensure compliance with requirements.

In addition to being the UK aviation safety regulator, the UK CAA is tasked with the regulation of occupational health and safety on board UK registered aircraft through the requirements of the Civil Aviation (Working Time) Regulations 2004. This requires an employer to ensure that each crew member employed by him is at all times during the course of that employment provided with adequate health and safety protection and prevention services or facilities appropriate to the nature of his or her employment.

INTENTIONALLY LEFT BLANK

List of Figures and Tables

Report:

Figure 1:	Number of Responses Received	20
Figure 2:	UK Respondents' Experience with In-Flight Fire	21
Figure 3:	UK Respondents' Perception on the Amount of Time Spent on Theoretical Fire Training	22
Figure 4:	UK Respondents' Perception on the Amount of Time Spent on Practical Fire Training	23
Figure 5:	UK Respondents' Attitude on the Adequacy of Training for Fire Behind Cabin Panels	24
Figure 6:	UK Respondents' Attitude on the Adequacy of Training for Simultaneous, Multiple Fires	26
Figure 7:	UK Respondents' Attitude on the Adequacy of Training for Fire Visible in the Cabin	27
Figure 8:	UK Respondents' Attitude on the Adequacy of Training for Management of Passengers	29
Figure 9:	UK Respondents' Frequency of Practical Fire Training	31
Figure 10:	UK Respondents (Without In-flight Fire Experience) Attitude towards Frequency of Practical Fire Training	31
Figure 11:	UK Respondents (With In-flight Fire Experience) Attitude towards Frequency of Practical Fire Training	32
Figure 12:	UK Respondents' Attitude on the Realism of Fire Conditions during Training	33
Figure 13:	UK Respondents' Attitude on the Realism of Smoke Conditions during Training	36
Figure 14:	UK Respondents' Attitude towards the Similarity of Equipment Used in Training with the Equipment On board Aircraft	38
Figure 15:	UK Respondents' Attitude on How Representative the Training Facility is of an Actual Aircraft Cabin	40
Figure 16:	UK Respondents' Attitude towards the Relevancy of Training Scenarios to Aircraft Operation	42
Figure 17:	UK Respondents' Attitude on How the Procedures Taught in Fire Training Correspond to the Procedures in Crew Operating Manuals	44
Figure 18:	UK Respondents' Attitude on the Appropriateness of Procedures for Communication and Coordination between Flight Crew and Cabin Crew during an In-flight Fire	46

Figure 19:	UK Respondents' Attitude on the Appropriateness of Procedures for Communication and Coordination between Cabin Crew during an In-flight Fire	48
Figure 20:	Problems Encountered during In-flight Firefighting Reported by UK Respondents	49
Figure 21:	Demonstration of a Switchboard Fire Using a CO ₂ Extinguisher (for Horn and Bayonet Fittings)	68
Figure 22:	"Storeroom" Fire	68
Figure 23:	Trainees Practicing Extinguishing Galley Fire with AFFF Extinguisher	69
Figure 24:	Fire Fighting Training Unit	70
Figure 25:	Galley Fire Rig and Bunk-bed Fire Rig on Middle Deck	70
Figure 26:	Passageway with Firefighting and Safety Equipment Stowage and Television Fire Rig on Middle Deck	71
Figure 27:	Machinery Control Room Fire Rig and Engine Fire Rig on Lower Deck	71
Figure 28:	VC10 Cabin Model for Training/Examination in Locations of Safety Equipment	74
Figure 29:	RAF Brize Norton Air Crew Smoke and Fire Training Facility	76
Figure 30:	Galley Fire Scenario at the Smoke and Fire Training Facility	76
Figure 31:	Toilet Fire Scenario at the Smoke and Fire Training Facility	77
Figure 32:	Number of Relevant In-flight Fire/Smoke Occurrences per Million Flights by Year	82
Figure 33:	Rate of In-flight Fire/Smoke Occurrences Relevant to This Study per Million Flights based on UK Mandatory Occurrence Reports	86
Figure 34:	Rate of in-flight Fire/Smoke Occurrences per Million Flights based on UK Mandatory Occurrence Reports with a Severity Score of 11 and Above	87
Figure 35:	Grouping of Fire Locations for MOR Occurrences with a Severity Score of 11 and above	88
Figure 36:	Frequency of Occurrence per Million Flights for Each Fire/Smoke Location – Comparison between MOR Data and SDR Data	89
Figure 37:	Percentage of In-flight Fire Occurrences where Problems were Encountered by Cabin Crew during Firefighting	91
Figure 38:	Breakdown of Reported Cabin Crew Problems	91
Figure 39:	Growth in Average Flight Time of Western-World Fleet since 1987	103
Figure 40:	Growth in Average Flight Time of UK Fleet since 1987	104
 Appendix 2:		
Figure 1:	Severity v Frequency of Occurrence - All MOR Data	2
Figure 2:	Cumulative Probability of a Diversion or Return to Departure Airport v Fire Severity Score - All MOR Data	3

Report:

Table 1:	List of Operators Reviewed	4
Table 2:	Details of Fire Training of the Operators Reviewed	5
Table 3:	Fire/Smoke Location Descriptions and Categories	84
Table 4:	Proportion of Occurrences with a Severity Score of 11 and above in Each Location Category	88
Table 5:	Comparison between SDR and MOR Data	90
Table 6:	Description of Reported Cabin Crew Problems	92

Appendix 2:

Table 1:	Fire/Smoke Severity Rating	1
Table 2:	Occurrence Severity Category	2

Appendix 3:

Table 1:	Accident Data	1
Table 2:	Recommendations	17

INTENTIONALLY LEFT BLANK

Acknowledgements

RGW Cherry & Associates Limited and the UK Civil Aviation Authority would like to express their gratitude to all parties who have supported and contributed to this project, including the operators and training organisations who participated in the review of the cabin crew training programmes, the organisations and websites who helped in promulgating the online survey and the respondents who participated in the survey, the Royal Navy, the Royal Air Force, Eurostar, the US Federal Aviation Administration, and Transport Canada Civil Aviation.

INTENTIONALLY LEFT BLANK

Executive Summary

One of the most serious threats in air transportation today is an in-flight fire. Cabin crew and flight crew actions are the primary line of defence in such an occurrence. It is therefore essential that they have the most appropriate training to deal with the threat.

The UK CAA considered it timely to review overall cabin crew training needs to ensure that cabin crew have the most appropriate skills to fully match current and future fire threats, and contracted RGW Cherry & Associates Limited to carry out this review and make recommendations to them with regard to any perceived deficiencies in current training practice.

The broad objectives of this study were to evaluate current and possible future issues, and identify potential improvements to existing fire training in order to ensure that cabin crew have the most appropriate training and procedures to match current and likely future fire threats.

This study took into account the need for realistic fire training, taking into consideration potential Health and Safety Executive implications and possible restrictions, as well as the very large number of cabin crew operating in the UK (in early 2008, approximately 32,000 cabin crew were operating on UK Air Operator Certificate holders' aeroplanes) In fatal accidents involving in-flight fire, the time lapse between crew awareness of a fire situation to the time that the fire has become catastrophically uncontrollable is between seven and 35 minutes. With this consideration, and the fact that the implications of even a modest increase in individual training costs could be substantial to the industry, the potential costs of any training changes need to be considered against the potential benefits.

This study was conducted based on the requirements of JAR-OPS 1, Subpart O – Cabin Crew. In terms of the cabin crew fire training, the requirements of JAR-OPS 1 are essentially the same as those in EU-OPS which came into force from 16 July 2008. It should be noted that EU-OPS applies to all European Community aeroplanes being operated for commercial air transportation. It will eventually be subsumed under European Aviation Safety Agency Implementing Rules together with any associated JAR-OPS Advisory Material. In this study, the recommendations for any changes in the requirements were therefore proposed as amendments to the "future European aviation requirements".

This report addresses the activities carried out in the study during which the following tasks have been performed:

- 1 **A review of current cabin crew fire training programmes.** A representative selection of eight UK and two non-UK European fire training programmes were reviewed, in conjunction with visits to operators and 'third-party' training organisations.
- 2 **An assessment of the views and experiences of cabin crew, flight crew and those engaged in fire training.** This task was carried out by means of an online survey.
- 3 **An assessment of some of the fire training currently carried out in non-civil aviation environments.** An assessment of the fire training carried out by the Royal Air Force, the Royal Navy and Eurostar (one of the channel tunnel train operators) was carried out.
- 4 **A review of the experience gained from in-flight fire occurrences and how the threats experienced might change in the future.** This task was primarily aimed at reviewing past in-flight fire occurrences, based on incident and accident data, to identify the characteristics of the fire and problems that were encountered in firefighting. An assessment was also made of the likely nature of future in-flight fire threats.

5 **An identification of potential improvements to cabin crew fire training.** Based on the current and potential threats identified in the accident/incident review and the likely deficiencies that might exist in current training programmes, as observed in other tasks, the potential improvements to cabin crew fire training were determined.

6 **Evaluation of potential improvements based on findings of the study, review of current regulatory material and foreign comparable regulatory material, and cost-benefit consideration.**

The potential improvements, listed below, were evaluated using a methodology based on the EASA Pre-Regulatory Impact Assessment (not in priority order, see 9.1.1).

- 1 Standards for Fire Extinguishers Used in Training
- 2 Standards for Protective Breathing Equipment Used In Training
- 3 Standards for Fires Used in Training
- 4 Standards for Smoke Training
- 5 Standards for Fire and Smoke Training Facilities
- 6 Standards for Fire Training Instructors
- 7 Evaluation Criteria in Practical Fire and Smoke Training
- 8 Theoretical Training in Fire Prevention Measures
- 9 Theoretical Training in Communication/Coordination with Flight Crew During an In-Flight Fire/Smoke Event
- 10 Practical Training in Communication/Coordination with Flight Crew During an In-flight Fire/Smoke Event
- 11 Practical Training in Communication/Coordination with Other Cabin Crew During an In-flight Fire/Smoke Event
- 12 Theoretical Training in Detecting and Locating Source of Smoke and Fire
- 13 Practical Training in Detecting and Locating Smoke/fire
- 14 Theoretical and Practical Training for Dealing with Hidden Fires
- 15 Practical Training in Removing Firefighting Equipment from Stowage during Fire and Smoke Training
- 16 Practical Training in Removing Protective Breathing Equipment from Packaging
- 17 Theoretical and Practical Training in the Management of Passengers during In-Flight Fire/Smoke Events
- 18 Requirement for Fire Scenarios Addressed in Training
- 19 Requirement for the use of Protective Equipment during Firefighting Training
- 20 Requirement for Theoretical Training in Conversion and Differences Training and Recurrent Training
- 21 Requirement for the Regulation of Training Provided by 'Third-Party' Training Organisations
- 22 Guidelines for Training Methods in Performing Firefighting Procedures
- 23 Guidelines for Implementing Integrated Fire Training Scenarios in a Cabin Environment
- 24 Guidelines for Training Methods in Emphasising the Required Urgency of Response to In-Flight Fires

References

- 1 UK Civil Aviation Authority. (2005). Worldwide Aircraft Hours and Landings Database. United Kingdom: UK Civil Aviation Authority
- 2 Cabin Safety Research Technical Group Accident Database Issue 30. United Kingdom: RGW Cherry & Associates Limited (2007)
- 3 Aviation Safety Network Accident Database, <http://aviation-safety.net/>
- 4 The National Transportation Safety Board Accident Database, <http://www.nts.gov/>
- 5 Blakey, Marion C. (2002, January 4). *Safety Recommendations A-01-83 through -87*. Washington, DC: US National Transportation Safety Board.
- 6 Airbus S.A.S. (2004). *Airbus Global Market Forecast 2004-2023*. Retrieved December 2007, from http://www.airbus.com/store/mm_repository/pdf/att00003033/media_object_file_GMF2004_full_issue.pdf
- 7 International Air Transport Association. (2007, August 31). *Industry Registers Record Traffic Volumes* [Press release No. 29]. Retrieved December 2007, from <http://www.iata.org/pressroom/pr/>
- 8 Transportation Safety Board of Canada. (2003). *Aviation Investigation Report: In-Flight Fire Leading to Collision with Water, Swissair Transport Limited, McDonnell Douglas MD-11 HB-IWF, Peggy's Cove, Nova Scotia 5 nm SW, 2 September 1998*.
- 9 Thales. (2006, July 17). *Innovation in passenger comfort: In-Flight Entertainment* [Press release]. Retrieved December 2007, from <http://www.thalesonline.com/>
- 10 Transport Canada Civil Aviation Flight Attendant Training Standard TP 12296 Issue 05, April 15, 2005. Retrieved 9 May 2008, from <http://www.tc.gc.ca/CivilAviation/publications/tp12296/>
- 11 United States Federal Aviation Regulation Part 121 Subpart N Section 121.417 Amdt. 121-281 (effective date 5/12/2004). Retrieved 23 April 2008, from <http://rgl.faa.gov>
- 12 US Federal Aviation Administration. (2004). *Advisory Circular No. 120-80 – In-Flight Fires*. Washington, DC: US Department of Transportation.
- 13 FAA's Flight Standards Information Management System Volume 3 General Technical Administration (8900.1 DHG 0, effective 9/13/2007), Chapter 23 (Flight Attendant Training and Qualification Programs), Section 6 (Cabin Safety and Flight Attendant Training). Retrieved 28 April 2008, from <http://www.fsims.faa.gov>
- 14 International Civil Aviation Organization – Working Paper, A36-WP/206, TE/63, 17/9/07, *Halon Replacement in Civil Aviation Aircraft*. Retrieved April 2008, from <http://www.icao.int>
- 15 United Nations Environment Programme. (2006). *2006 Report of the Halons Technical Options Committee – 2006 Assessment*. Retrieved April 2008, from <http://www.icao.int>

INTENTIONALLY LEFT BLANK

Glossary

AAIB	Air Accidents Investigation Branch (UK)
ABP	Able Bodied Person
AC	Advisory Circular (FAA)
AFFF	Aqueous Film-Forming Foam
AFM	Aircraft Flight Manual
AOC	Air Operators Certificate
BCF	Bromochlorodifluoromethane (Halon 1211)
BEA	Bureau d'Enquêtes et d'Analyses (French Accident Investigating Authority)
CAP	Civil Aviation Publication
CCS	Common Core Skills
CFHR	Centre-Fed Hose Reel
CRM	Crew Resource Management
EASA	European Aviation Safety Agency
EDBA	Extended Duration Breathing Apparatus
EEBD	Emergency Escape Breathing Device
EU-OPS	European Union Operations Regulations
FAA	Federal Aviation Administration (US)
FFTU	Fire Fighting Training Unit
FODCOM	Flight Operations Department Communication
IATA	International Air Transport Association
IFE	In-Flight Entertainment
JAR-OPS	Joint Aviation Regulations – Operations
MOR	Mandatory Occurrence Report
NFPA	National Fire Protection Agency (US)
NTSB	National Transportation Safety Board (US)
PBE	Protective Breathing Equipment

PED	Portable Electronic Device
PFI	Private Finance Initiative
QRH	Quick Reference Handbook
SCBA	Self-Contained Breathing Apparatus
SCCM	Senior Cabin Crew Member
SDR	Service Difficulty Reports (US)
SEP	Safety and Emergency Procedures
SNCB	Société Nationale de Chemins de fer Belges (Belgian national railway company)
SNCF	Société Nationale de Chemins de fer Français (French national railway company)
SSEP	Standing Sea Emergency Party
TCCA	Transport Canada Civil Aviation
TNA	Training Needs Analysis
TSB	Transportation Safety Board (Canada)
UK CAA	United Kingdom Civil Aviation Authority

Additional Notes on Terms

Throughout this document references were made to Operations Manuals and Training Manuals, as well as individual operator references and terminology for flight crew operating manuals and cabin crew operating manuals, etc. All such manuals are part of a Suite of 'Operations Manuals' required by JAR-OPS 1 Subpart P.

Cabin Crew Fire Training - Training Needs Analysis

1 Introduction

1.1 Background

One of the most serious threats in air transportation today is an in-flight fire. Cabin crew and flight crew actions are the primary line of defence in such an occurrence. It is therefore essential that they have the most appropriate training to deal with the threat.

Accident and incident experiences have led the UK CAA to believe that current training practices and standards may no longer be totally appropriate to current and likely future in-flight fire threats. Whilst individual changes have been made based on incidents and operational changes, the UK CAA considered it timely to review overall cabin crew training needs to ensure that cabin crew have the most appropriate skills to fully match current and future fire threats. RGW Cherry and Associates Limited has carried out this review and made recommendations to the UK CAA and the EASA with regard to perceived deficiencies in current cabin crew fire training practice.

1.2 Objectives

The objectives of this study were to assess the overall cabin crew fire training needs based on a review of current training and identification of current and possible future threats, and to identify and evaluate potential improvements to cabin crew fire training and propose recommendations, including amendments to future European aviation requirements.

1.3 Requirement for Cabin Crew Fire Training In JAR-OPS 1

The Training Needs Analysis was conducted taking into account the requirements of JAR-OPS 1 Subpart O – Cabin Crew. In brief, these are divided into three types of training:

- **Initial Training (JAR-OPS 1.1005):** This specifies the theoretical fire training.
- **Conversion and Differences Training¹ (JAR-OPS 1.1010):** This specifies the practical fire training using fire extinguishers to extinguish a fire and the use of Protective Breathing Equipment (PBE) in a smoke-filled environment.
- **Recurrent Training (JAR-OPS 1.1015):** This includes the location and donning of PBE on an annual basis as well as emergency procedures, and on a three yearly basis using fire extinguishers to extinguish a fire and the use of PBE in a smoke-filled environment.

The following are the sections of the JAR-OPS 1, Subpart O requirements that are relevant to cabin crew fire training.

INITIAL TRAINING – Appendix 1 to JAR-OPS 1.1005

- (a) An operator shall ensure that all elements of Initial Training are conducted by suitably qualified persons.
- (b) Fire and smoke training. An operator shall ensure that fire and smoke training includes:

1. **Conversion training** must be completed before the cabin crew member is first assigned by the operator or assigned to operate another aeroplane type. **Differences training** must be completed before operating on a variant of an aeroplane type currently operated or with different safety equipment, safety equipment location, or normal and emergency procedures on currently operated aeroplane types or variants.

- (1) Emphasis on the responsibility of cabin crew to deal promptly with emergencies involving fire and smoke and, in particular, emphasis on the importance of identifying the actual source of the fire;
- (2) The importance of informing the flight crew immediately, as well as the specific actions necessary for coordination and assistance, when fire or smoke is discovered;
- (3) The necessity for frequent checking of potential fire-risk areas including toilets, and the associated smoke detectors;
- (4) The classification of fires and the appropriate type of extinguishing agents and procedures for particular fire situations, the techniques of application of extinguishing agents, the consequences of misapplication, and of use in a confined space; and
- (5) The general procedures of ground-based emergency services at aerodromes.

CONVERSION AND DIFFERENCES TRAINING – Appendix 1 to JAR-OPS 1.1010

- (a) General. An operator shall ensure that:
 - (1) Conversion and Differences Training is conducted by suitably qualified persons; and
 - (2) During Conversion and Differences Training, training is given on the location, removal and use of all safety and survival equipment carried on the aeroplane, as well as all normal and emergency procedures related to the aeroplane type, variant and configuration to be operated.
- (b) Fire and smoke training. An operator shall ensure that:
 - (1) Each cabin crew member is given realistic and practical training in the use of all fire fighting equipment including protective clothing representative of that carried in the aeroplane. This training must include:
 - (i) Each cabin crew member extinguishing a fire characteristic of an aeroplane interior fire except that, in the case of Halon extinguishers, an alternative extinguishing agent may be used; and
 - (ii) The donning and use of protective breathing equipment by each cabin crew member in an enclosed, simulated smoke-filled environment.

- (e) Evacuation procedures and other emergency situations. An operator shall ensure that:

- (2) Each cabin crew member is trained to deal with the following:
 - (i) An in-flight fire, with particular emphasis on identifying the actual source of the fire;

- (h) Safety equipment. An operator shall ensure that each cabin crew member is given realistic training on, and demonstration of, the location and use of safety equipment including the following:

- (6) Fire extinguishers;
- (7) Fire axe or crow-bar;
- (8) Emergency lights including torches;

- (13) Other cabin safety equipment or systems, where applicable.

RECURRENT TRAINING – Appendix 1 to JAR-OPS 1.1015

- (a) An operator shall ensure that Recurrent Training is conducted by suitably qualified persons.
- (b) An operator must ensure that every 12 calendar months the programme of practical training includes the following:
- (1) Emergency procedures including pilot incapacitation;

- (4) The location and handling of emergency equipment, including oxygen systems and the donning by each cabin crew member of lifejackets, portable oxygen and protective breathing equipment (PBE);
- (c) An operator shall ensure that, at intervals not exceeding three years, Recurrent Training also includes;

- (3) Each cabin crew member being given realistic and practical training in the use of all fire-fighting equipment, including protective clothing, representative of that carried in the aeroplane. This training must include:
- (i) Each cabin crew member extinguishing a fire characteristic of an aeroplane interior fire except that, in the case of Halon extinguishers, an alternative extinguishing agent may be used; and
 - (ii) The donning and use of protective breathing equipment by each cabin crew member in an enclosed, simulated smoke-filled environment.

2 Review of Cabin Crew Fire Training Programmes

A representative selection of UK operator cabin crew fire training programmes was reviewed to benchmark current practice. Visits were carried out to review the training programmes for eight UK AOC holders (operators) between 30 October and 30 November 2007 and two non-UK European operators were visited in December 2007 and January 2008. No operator or 'third-party' training organisation was identified to the CAA.

The visits to operators and training organisations were conducted taking into account the requirements of JAR-OPS 1 Subpart O – Cabin Crew, as specified in Section 1.3.

A cross-section of operation types was involved in the visits and included, regional/ domestic, intra-European, and long haul. These included scheduled, charter and low-cost operators. A cross-section of aeroplane types were utilised by the operators subjected to the study and included both turbo-prop, as well as narrow-bodied and wide-bodied jet operations (see Table 1).

Table 1 List of Operators Reviewed

OPERATOR	FLEET	OPERATIONS	DESTINATIONS
UK Operator 1	Narrow/wide body	Scheduled	Domestic/European/Long Haul
UK Operator 2	Narrow body	Scheduled (low cost)	Domestic/European
UK Operator 3	Regional aeroplane (single cabin crew & 2 cabin crew)	Scheduled	Domestic/ limited routes near European
UK Operator 4	Narrow/wide body	Charter	European/Long Haul
UK Operator 5	Narrow/wide body	Scheduled Charter	European/Long Haul
UK Operator 6	Wide body	Scheduled	Long Haul
UK Operator 7	Regional aeroplane (single cabin crew)	Scheduled, some charter and ad hoc	Domestic/limited routes near European
UK Operator 8	Regional aeroplane (single cabin crew and 2 cabin crew)	Scheduled	Domestic/limited routes near European
Non-UK European Operator 1	Narrow body	Scheduled (low cost)	European
Non-UK European Operator 2	Narrow body	Charter	European/Long Haul

Of the ten operators reviewed, six of the UK operators utilised 'third-party' training organisations to carry out their cabin crew fire training. Of these, five were Airport Fire Services. One operator utilised a 'third-party' training organisation to conduct the fire training in their own in-house training facility.

Three UK operators were visited who operated aeroplanes with only one cabin crew member, on at least one of the aeroplane types operated.

The UK current practice was compared to North American best practice, which was represented by a US training organisation recommended to the authors by the US FAA. The flight attendant (cabin crew) training provided by this organisation is more directed towards corporate jet operations. The information on their fire training was obtained by means of a questionnaire.

One operator has introduced practical recurrent fire training on a yearly basis, whilst another operator provided practical recurrent fire training every two years. One operator provided practical Protective Breathing Equipment (PBE) training in a smoke-filled environment on an annual basis. The other operators provided three-yearly practical PBE training as required by JAR-OPS.

2.1 Variations in the Duration of The Training

Table 2 shows the variation in the duration of fire training. Of particular interest is the time spent on Recurrent Training.

The JAA Temporary Guidance Leaflet Number 3 (Guidance for Operators in Compiling Procedures and Training Programmes for Cabin Crew), states that the syllabus in the Operations Manual should include an indication of the duration of each training session. However, as with all cabin crew training, JAR-OPS 1 requirements do not prescribe the duration of fire training. The differences in the duration of the fire training reflected in Table 2 might raise questions as to the effectiveness of Initial and Conversion and Differences Training, as well as Recurrent Training, for those operators who provide the shortest training times.

However, since the requirements of JAR-OPS 1 do not provide any specific detail as to what is expected in terms of cabin crew fire training then it is likely that operators who are spending the most time on fire training may be doing so over and above the specified requirements. It should be noted that the disparity in the amount of time provided for fire training may be in part due to the way that the fire training is organised by some operators and that in some cases the training is divided into more than one training session. This may especially be the case, when different parts of the fire training had been conducted by both the operator and the 'third-party' training organisation.

Table 2 Details of Fire Training of the Operators Reviewed

OPERATOR	THEORETICAL TRAINING	PRACTICAL TRAINING	TYPE OF TRAINING OBSERVED	DURATION	NUMBER ON THE COURSE
UK Operator 1	In-house	In-house	Recurrent	1 hour	12 cabin crew
UK Operator 2	In-house	In-house	Initial & conversion and differences	7.5 hours	18 new-entrant cabin crew
UK Operator 3	In-house, but some elements repeated in 3 rd party training	3 rd party	Initial & conversion and differences	3 hours	4 new-entrant cabin crew & 3 flight crew
UK Operator 4	3 rd party (Using In-house facilities)	3 rd party (Using In-house facilities)	Recurrent	4 hours	16 cabin crew & 6 flight crew

Table 2 Details of Fire Training of the Operators Reviewed (Continued)

OPERATOR	THEORETICAL TRAINING	PRACTICAL TRAINING	TYPE OF TRAINING OBSERVED	DURATION	NUMBER ON THE COURSE
UK Operator 5	In-house, minimal recap by 3 rd part	3 rd party	Recurrent	5 hours	19 cabin crew & 1 flight crew
UK Operator 6	In-house, but some elements repeated in 3 rd party training	3 rd party	Initial & conversion and differences	7.5 hours	18 new entrant cabin crew
UK Operator 7	In-house, but some elements repeated in 3 rd party training	3 rd party	Initial & conversion and differences	3 hours	4 cabin crew **, 2 flight crew
UK Operator 8	In-house, but some elements repeated in 3 rd party training	3 rd party	Initial & conversion and differences	3 hours	4 new entrant cabin crew
Non-UK European Operator 1	In-house at regional bases	In-house at central location	Initial & conversion and differences	3 hours	26 new-entrant cabin crew
Non-UK European Operator 2	In-house	In-house, but using another operator's fire training facility	Initial & conversion and differences	4.5 hours	15 new entrant cabin crew

** Note: two cabin crew were undertaking Initial Training combined with Conversion and Differences Training and two were undertaking Recurrent Training. The content of the practical component for both courses was the same.

The US training organisation evaluated in this study has on average 6 trainees in a training session. Theoretical fire training for Initial and Recurrent Training in this organisation takes approximately 1 hour.

2.2 Firefighting Equipment Used in Training

There were many equipment issues identified during the course of the visits. The main two problems were with training equipment used for Halon training fire extinguishers and Protective Breathing Equipment (PBE).

Use of Halon in training and the restrictions on Halon discharge

Since, in 1992, the Montreal Protocol prohibited the discharge of Halon for training purposes, the lack of realism for cabin crew (and flight crew) practical Halon extinguisher training is a major issue. The usual means of achieving the JAR-OPS 1 training requirement is by using a Halon fire extinguisher charged with water. However, this in no way replicates the firefighting characteristics of Halon on a live fire, and therefore there is an obvious disconnect between the training requirements, the training being delivered and the actual scenario that is likely to be encountered in the event of an in-flight fire.

When the restrictions on the use of Halon were first implemented in the UK, the Civil Aviation Authority considered it important that cabin crew were provided with additional information on the application of Halon extinguishers in different fire scenarios. The CAA provided technical support to a video producer and subsequently agreed an in-flight fire training video that identified some of the training shortfalls of not being able to use Halon during fire training.

It is likely that the current procedures used in training are not able to demonstrate to cabin crew the characteristics of Halon and its effectiveness in dealing with an in-flight fire. The use of a Halon extinguisher charged with water to fight a fire of a small scale, does not in any realistic way provide the cabin crew with the experience of Halon discharge and the way that it reacts with fire, and its effectiveness in extinguishing a fire. A training video that specifically addresses this issue would be of benefit, since it would appear that none of the current training videos specifically deals with the way that Halon interacts with fire and its effectiveness (see also Section 2.2.3 - Fire extinguisher integral seals)

2.2.1 Use of fire extinguishers in training

The JAR-OPS 1 requirements state that fire extinguishers used in practical training should be representative of those carried in the aeroplanes to be operated by the cabin crew. Whilst some operators used Halon fire extinguishers of the type carried on board their aeroplanes during practical training, but charged with water, others used water fire extinguishers, many of which were not representative. In some cases the fire extinguishers were similar in operation but significantly different in size and weight, i.e. much larger than those carried on the aeroplanes operated, and on one occasion the fire extinguishers bore no resemblance to those carried on board the operator's aeroplanes. In one case, 2-litre water fire extinguishers were used, i.e. twice the size of those carried on the operator's aeroplanes.

The US training organisation evaluated in this study uses fire extinguishers identical to those installed on the operator's aeroplane, including the seals. Dry powder is used as the extinguishing agent during their training due to its having the advantage of a visual reference. Additionally, dry powder has less impact on their training devices than water. The use of a water extinguisher is practiced by discharging it into a large dustbin (trash can) (without fire).

In at least one case, differences between the operation of the fire extinguishers used in training and the actual equipment carried on the operator's aeroplane was emphasised throughout the practical training. This emphasis during training is considered essential given the significant differences between the fire extinguishers, the extinguishing agent, and the training equipment and this should be included in all fire training.

Some operators had two or three different types of fire extinguisher but only used one of the types during practical training. It is questionable whether using only one fire extinguisher in training, when more than one type of extinguisher is carried, actually meets the JAR-OPS 1 requirements. If it does, it might be asked whether this is actually sufficient.

Whilst JAR-OPS 1 requires the removal of all safety equipment from its location on the aeroplane during Conversion and Differences Training, there was little evidence that this was covered during the practical training that was observed in this study. However, most operators stated that this was achieved during an aircraft visit. There is no requirement in JAR-OPS 1 that removal of fire extinguishers is conducted during Recurrent Training. This means that a cabin crew member may go many years without removing a fire extinguisher from its stowage and this unfamiliarity might cause a delay in the access to and removal of the equipment. Additionally, if a change

in the location and stowage of the equipment is made, which is quite likely in the lifetime of an aeroplane fleet, the cabin crew member may not have ever removed a fire extinguisher from its re-positioned stowage.

As a comparison, removal of firefighting equipment from its stowage is included in the cabin crew practical fire training scenario provided by the US training organisation evaluated in this study.

2.2.2 **Procedures and realism of fire extinguishers in training**

The procedures and the realism used for the training of cabin crew in the use of extinguishers varied significantly amongst operators, and with 'third-party' training organisations. The differences in the training observed might in part be due to a lack of specific training requirements in JAR-OPS.

It was observed during the visits that some operators/training organisations do not cover all in-flight fire types relevant to the aeroplane operated during theoretical training – although they may be addressed in the Operations Manual.

The severity of the fires that cabin crew were exposed to varied from a very large galley fire to a very small fire in an oven. In only one case were the cabin crew exposed to fire and heat in a large volume, and in this case a CO₂ extinguisher was used to extinguish the fire(s). Whilst the use of a CO₂ extinguisher in this case is not at all consistent with the extinguishers carried on board the operator's aeroplane, there might be some benefit in giving cabin crew the experience of being exposed to a large fire, since each of these cabin crew were of the opinion that they gained confidence in extinguishing a fire of such a large size.

In several cases, a gas-powered fire rig was utilised and the intensity of the fire was usually moderate. The problem in the use of some gas-powered training devices is that the fire source is controlled by the instructor who terminates the gas supply when they determine that the cabin crew member has demonstrated their proficiency in extinguishing the fire. In one case, the gas supply could be terminated by the correct use of the fire extinguisher, or by the instructor turning off the gas supply. In some cases, the assessment of proficiency by the instructor was considered somewhat arbitrary. It was therefore considered important that instructors providing such training should follow specific standards and be trained on how to implement these standards in a consistent way.

In cases where the gas supply was turned off and the cabin crew member had not actually extinguished the fire, it is arguable whether the requirements of JAR-OPS 1 have actually been met.

In one case, although each cabin crew member actually extinguished a fire using a CO₂ extinguisher, only 50% of the course trainees actually extinguished a fire using a Halon extinguisher charged with water (Halon being the type of extinguisher carried on board the operator's aeroplane).

In another case, the practical fire fighting exercise involved a small fire in an oven. Although each new entrant cabin crew member (trainee) actually discharged a small amount of the Halon extinguisher charged with water into the oven, in many cases the fire had already been extinguished by the initial action of the trainee closing the oven door. In this case, only 50% of the trainees actually extinguished a fire and as a result, there was a significant shortfall in compliance with the requirements of JAR-OPS.

The fire scenarios that cabin crew had to deal with varied considerably depending on the facilities of the operator and the 'third-party' training organisation. In some cases, a gas-powered fire rig simulated a variety of fire scenarios, such as fires in overhead bins, ovens, waste carts, seats and behind a cabin panel. Each cabin crew member would be required to fight one of these fire scenarios.

In one case cabin crew extinguished oven fires and galley fires even though ovens were not installed on the aeroplanes to be operated.

In one case, a live fire of minimal intensity was provided by a small quantity of shredded paper located in a container measuring approximately 30 cm x 30 cm.

In much of the training that was observed, the fire scenarios presented little challenge to the trainees. In some cases it would be difficult to see how there would be any real problem in the trainee or cabin crew member extinguishing the fire, and in some of the training that was observed in the study, the JAR-OPS 1.1010 and 1.1015 requirements were not actually achieved. The ease in which most of the fires encountered in training were extinguished, may lead cabin crew to a false sense of security or confidence. This may detract from the urgency of the situation and that all in-flight fire and smoke situations must be dealt with immediately and aggressively. In most cases, re-ignition of the fire did not occur, which again demonstrates the ease with which the fires were dealt with.

However, one 'third-party' training organisation used a large coach, representing an aeroplane with a single-aisle separating two double seats, for both the fire extinguisher and PBE training. A door had been installed at the rear of the unit to represent the operator's aeroplane cargo door, and adjacent to this was an area with some actual aeroplane galley equipment, both positioned in the same or similar location to the operator's configuration. In spite of the fact that a coach was used for practical training, it was considered that the environment was similar to the operator's aeroplane and that the training was conducted in a meaningful way, consistent with the operator's aeroplane and operating procedures. In this case, the cabin crew had to first contact the flight crew and then commence the full fire drill, including donning PBE, locating and obtaining the fire extinguisher, fighting the fire (small live fire created by a domestic wax firelighter and some paper inside a canister located behind "cargo door") and subsequent dampening down by using non-flammable liquid and representative galley equipment. Management of passengers and communication with the flight crew was continuous throughout this exercise. This exercise encompassed all aspects of the operator's smoke and fire drills, which provided a practical training session with a high degree of realism.

Whilst in some cases there were obvious problems in consistency between operators and 'third-party' training organisations, there were at least two examples as to how such difficulties could be overcome, if addressed efficiently.

Many of the cabin crew/trainees observed undergoing fire extinguisher training, did not actually extinguish a fire, or extinguish a fire using the extinguisher type carried on their aeroplanes.

In only two cases, cabin crew fought a fire whilst wearing Protective Breathing Equipment (PBE).

At the US training organisation evaluated in this study, each cabin crew member has to locate and extinguish a live fire while wearing PBE in the "fire trainer". The drills usually take approximately one to two minutes per cabin crew. The fire generated has medium to large flames. The propane fire is controlled by the instructors from inside the trainer. The fire is extinguished by the cabin crew and verified by visual reference. The propane is immediately turned off by the instructor after the fire is 'extinguished'. There are also simulated fires requiring the use of circuit breakers to extinguish. The "fire trainer" used during this training is a Gulfstream fuselage equipped with four circuit breaker fire scenarios comprising of two galley fires, one entertainment system fire, and one lavatory fire.

2.2.3 Fire extinguisher integral seals

In December 1998 there was an in-flight fire in an overhead bin on board a UK registered wide-bodied aeroplane. Although the cabin crew responded quickly to the event, the cabin crew member who initially responded to the fire threat failed to exert enough pressure on the extinguisher operating handle to break the integral seal and initiate discharge of the Halon. This action was achieved by a passenger.

Although no Safety Recommendations were made by the AAIB on this incident due to the successful outcome of this emergency, the AAIB Bulletin made the following comments:

“The use of Halon (BCF) fire extinguishers is presently restricted to actual fires onboard and is not used solely for training purposes. This is a voluntary agreement in recognition of the environmental damage caused by Halon gas discharge. These extinguishers have a trigger mechanism and a considerable force is required to break the seal on first use. The training programme undertaken by the crew members did not allow for actual experience of the force required to break this seal, neither were crews given the opportunity to experience the effect of back pressure from the discharge of a full cylinder. Instead briefings were given to crewmembers on what to expect in the real situation and practical experience was given using a water filled extinguisher on which the seal had already been broken.”

One supplier manufactures brass seals that can be inserted into a training Halon extinguisher to replicate the forces needed to break the seal and to initiate Halon discharge. One of the operators visited did in fact use these seals on an individual basis for both cabin crew and flight crew during Conversion and Differences Training, as well as Recurrent Training. The use of such seals can confirm a cabin crew member's proficiency in operating the fire extinguisher and provides them with first-hand experience of the pressure needed to break the seal and achieve Halon discharge. It should be noted, however, that the issue of integral seals would appear to be a design issue affecting only one type of Halon extinguisher carried on board UK aeroplanes.

2.2.4 Use of Protective Breathing Equipment (PBE) in training

The provision of realistic PBE training is another difficult issue for both operators and training organisations. 'Operational' PBE is usually stowed inside a vacuum-packed container, which is stowed in a rigid or semi rigid box or container. To access the PBE, the box or container has to be opened, the vacuum pack removed, the vacuum pack opened, the PBE unit shaken out so it is ready for use, and the PBE finally donned and activated.

The only part of the procedure of using PBE that is practised is the actual donning of the PBE. This is usually conducted on training units with neck seals that do not replicate the tightness of the seals to be encountered on a operational unit. In one case the condition of some neck seals were in such a bad condition as so to be almost non-existent.

Additionally many significant characteristics of 'operational' PBE cannot be replicated with training units, such as 'quick-start' operation, manual start, heat generation and supply of breathable oxygen. These are factors that should provide the cabin crew member with a greater sense of confidence in the effectiveness of PBE.

In one case, the crew used PBE in practical training which was not carried on board the operator's aeroplanes.

In at least one case, the differences between the operation of the PBE used in training and the actual equipment carried on the operator's aeroplane was emphasised throughout the practical training. This emphasis during training is essential, given the

significant differences between the PBE and the training equipment, and consideration should be given to including it in all fire training.

Whilst JAR-OPS 1 requires the removal of all safety equipment during Conversion and Differences Training, there was little evidence that this was covered during practical training. However, some operators stated that this was achieved during an aircraft visit. There is no requirement in JAR-OPS 1 that removal of PBE is conducted during Recurrent Training. This means that a cabin crew member may go many years without removing PBE from its stowage and this unfamiliarity might cause a delay in the access to and removal of the equipment. Additionally, if a change in the location and stowage of the equipment is made, which is quite likely in the lifetime of an aeroplane fleet, the cabin crew member may not have ever removed PBE from its re-positioned stowage.

The US training organisation evaluated in this study uses an aviation-approved PBE manually filled with air from a self-contained breathing apparatus (SCBA) tank prior to commencing the drill training. The PBE drill does not include removal of the PBE from its container/packaging. The duration of time the trainees spend wearing the PBE is approximately one to two minutes, i.e. when they carry out the firefighting drill. The visibility in the smoke used during this drill ranges from approximately a half to three metres (or one to ten feet).

2.2.5 Procedures and realism of PBE training

The procedures and the realism used for the training of cabin crew in the use of PBE also varied significantly amongst operators, and 'third-party' training organisations. Again, the differences in the training that were observed might in part be due to a lack of specific training requirements in JAR-OPS.

In one case, the necessity of speed in donning PBE was stressed with cabin crew having to achieve this in 15 seconds. This was timed on an individual basis using a stopwatch. Whilst this achieved a sense of urgency, not elsewhere observed in practical training, the exercise still remained unrealistic as the PBE training units were immediately 'at hand' rather than in the PBE stowages, and were disproportionately easy to don due to the poor state of the neck seals.

In one case, only half of the cabin crew being trained actually donned PBE and used it in a smoke-filled environment and the PBE was not representative of that carried on the operator's aeroplanes.

The density of smoke varied considerably. The least restrictive was with full visibility from one end of an enclosed unit to the other. The most restrictive was with visibility down to one seat row (2-3 feet) and in darkness.

The duration that cabin crew actually used PBE in a smoke-filled environment also differed considerably; the minimum time was 20 seconds and the maximum was seven minutes. In the case where cabin crew were in smoke for only 20 seconds, this was during Recurrent Training, and involved the cabin crew just walking through a light "misting" of smoke with no workload.

In most Conversion and Differences Training, and Recurrent Training, the cabin crew were wearing PBE in a smoke-filled environment for between four and seven minutes with either a task to conduct, or a talk-through of the fire/smoke scenario with questions led by an instructor.

CAA Civil Aviation Publication (CAP) 360 used to specify that cabin crew had to don and use PBE in a smoke-filled environment for a minimum of five minutes whilst conducting some degree of workload. It would seem that whilst this is not a requirement in JAR-OPS, many operators implement such criteria since they believe that it is of value.

2.3 **Large Internal Fires, Multiple Fires and External Fires**

Only one operator included the issues relating to a large internal fire, by showing an FAA Technical Centre video on flashover.

External fires were dealt with by most of the operators but related to external hazards and evacuation.

No operator included the issues of multiple internal fires and most operators had not given this any consideration. Most operators were of the opinion that this would be difficult to manage, especially with smaller aeroplanes with only a limited number of cabin crew.

Most operators were on the opinion that there should be a procedure in place for multiple fires especially for operations with a limited number of cabin crew. With current procedures, to effectively deal with two separate simultaneous fires, a minimum of six cabin crew might be required.

2.4 **Crew Communications**

In most cases there appeared to be consistent procedures for communications between flight crew and cabin crew, and between cabin crew members. However, whilst the cabin crew were trained in general terms about the information required by the flight crew, in some cases the training on specific information differed.

In most cases, the cabin crew were not made aware of the high-level of flight crew workload at such a time with the flight crew planning for a diversion and emergency landing.

In most cases, the flight deck door was required to be kept locked (secured) during an in-flight fire situation. One exception to this was when a fire on the flight deck could not be successfully resolved by the flight crew and the intervention of the cabin crew was required to provide the necessary assistance. Another exception was where in the event of a hidden fire in the passenger compartment, cabin crew might require access to the crash axe or crowbar¹ stowed on the flight deck.

This gives concerns that for aeroplanes with less than 200 passenger seats installed, the only required crash axe or crowbar is stowed on the flight deck and that for those aeroplanes with reinforced flight deck doors installed, a further time delay in accessing this equipment might be detrimental to dealing with a hidden fire in the passenger cabin.

In respect of flight deck fires, in most cases there was little information provided during training apart from the need for the flight crew to be on oxygen before Halon was discharged on the flight deck. One operator had experienced a fairly recent fire on the flight deck and did review this incident in Initial Training. It was understood that this incident review would also be included in Recurrent Training.

In one case, the 'third-party' training organisation instructors lacked the specific knowledge of all aspects of the operator's procedures for communications.

Additionally, although the training indicated the difficulties of communicating when wearing PBE, there was little in the practical training to address this especially in conjunction with the use of a PA/interphone handset for communication with the flight crew or other cabin crew. For an account of accident and incident experience, relating to problems encountered with PBE and cabin crew communications, and subsequent recommendations made by accident investigation authorities see Sections 5.4.3 and 5.4.8.

1. In Subpart K (Instruments and Equipment), JAR-OPS 1.795 uses the terminology 'crash axe' and 'crowbar' instead of 'fire axe' and 'crow-bar' as used in JAR-OPS 1.1010. The former is used in this report for consistency (except when used within a quotation).

2.5 **Procedures of Ground-Based Emergency Services at Aerodromes**

Whilst all operators included the procedures of ground-based emergency services, as required by JAR-OPS 1.1005, one operator involved the local Airport Fire Service to a higher level than required.

In this case, the instructors and the operator's pilots visited the Airport Fire Service for training in the ground-based procedures. The Safety and Emergency Procedures (SEP) instructors provided the ground based procedures training to their cabin crew.

Additionally, members of the Airport Fire Service attended the operator's crew training in order to be familiar with the operator's relevant flight crew and cabin crew emergency procedures.

2.6 **Interface with Flight Crew and Flight Crew Training**

In most cases, it appeared that there was good interface between those responsible for cabin crew fire training and flight crew fire training.

However, in the case of two of the operators involved in this study the following was observed:

- The cabin crew training departments devised and delivered the cabin crew fire training based on the procedures written in the Cabin Crew Operations Manual.
- The flight crew were provided with the same practical fire training as cabin crew.
- However, the cabin crew training departments did not have access to the Flight Crew Operations Manual or the Flight Crew Training Manual, both of which were written by the flight crew departments without input from the cabin crew training departments.
- Therefore, in these two cases, the cabin crew training departments had no idea if the cabin crew procedures and the flight crew procedures were consistent.
- Consequently the practical fire training undertaken by the flight crew may not be consistent with the procedures in the flight crew manuals.

It was observed that the number of flight crew who received joint fire training with cabin crew was minimal.

In two cases, the cabin crew SEP instructors provided both the theoretical and the practical fire training for the cabin crew as well as the flight crew, and this appeared to provide a high level of consistency of the procedures, communication and coordination.

An in-flight fire demands that the flight crew and the cabin crew act as a team as rapidly as possible to deal with the situation. Given the little time that both the flight crew and the cabin crew may have to respond effectively to the threat, it would seem reasonable to consider giving more emphasis to joint training, which could also include many CRM elements as required by JAR-OPS.

The cabin crew fire training carried out by the US training organisation evaluated in this study includes practical training in communication and coordination procedures with the flight crew.

2.7 **Required Urgency of Response to an In-flight Fire Event**

Several operators used a video of the Bradford City Football Club stadium fire in the mid-1980's to show how quickly fire could spread. However, specific information on accidents involving actual in-flight fires, and the length of time taken before the fire became uncontrollable, was not included.

Although the urgency of response was included and emphasised by most of the operators, examples of actual in-flight fires and the time available to the flight crew and the cabin crew to successfully deal with the fire situation was not always stressed.

It was found that the US training organisation evaluated in this study emphasises the required urgency of response by timing the trainees' actions in performing the firefighting drill.

2.8 **Evaluation Criteria**

JAR-OPS 1 provides no criteria in respect of what should be expected in terms of demonstrating proficiency in relation to fire extinguisher and PBE training and therefore such criteria are left to individual operators and national aviation authorities to determine.

The US training organisation evaluated in this study conducts examinations to confirm trainees' proficiency in both theory and drill, in fulfilment of the requirements of FAR 121.417 (d) (see Section 8.7.4). The trainees are debriefed after each scenario drill and repeat the exercise at a later point in training. The trainees are only required to do one drill unless there is a need for additional training or if the attendee wants to do another scenario.

2.9 **Comparison Between Operations Manuals and Training Practice, and Compatibility Between Training Manuals and 'Third-Party' Training**

The content of the Operations Manual and consistency with training practice as reflected in Training Manuals appeared in most cases to be effective. This was very much the case for those operators who conducted all their own in-house training and for those operators who conducted their own in-house theoretical training. However, a problem arose with some 'third-party' training organisations, especially those who did not have access to relevant parts of their client's Operations Manuals or Training Manuals.

In one case, a 'third-party' instructor was uncertain of the type of Halon extinguisher that was carried on the operator's aeroplanes.

In one case, the 'third-party' training organisation was signing for completion of training being conducted in accordance with the operator's Training Manual without actually knowing what was in it.

In one case, despite all cabin crew demonstrating knowledge of, and proficiency in, the operator's procedures during theoretical training, many of the crew experienced some degree of difficulty in accurately applying this to the practical scenario(s).

In some cases the operator had little idea of what the 'third-party' training organisation were actually providing in the way of both theoretical and practical fire training, or whether they were compliant with the training requirements of JAR-OPS.

In some cases, the operator conducted virtually no check of the training being provided by the 'third-party' training organisation, and as stated above, sometimes the 'third-party' training organisation had little or no access to relevant sections of the operator's Operations Manual or Training Manual.

In one case, the 'third-party' training organisation instructors lacked the specific knowledge of all aspects of the operator's procedures for communications.

In one case a 'third-party' training organisation spent time on explaining the labelling of fire extinguishers not actually carried on commercial UK aeroplanes, for example, dry powder, CO₂ and foam.

However, in one case where the 'third-party' training organisation conducted both the theoretical and practical fire training in the operator's in-house training facility, it appeared that there was a high level of consistency between the operator's procedures and the training provided. In this case the 'third-party' training organisation provided a dedicated instructor, had access to both the Operations Manual and the Training Manual, was audited by the operator on a regular basis and was involved in the development of the operational fire fighting procedures, as well as the content and provision of the training.

In another case the 'third-party' training organisation did have access to the operator's Safety and Emergency Procedures (SEP) Manual. In this case the training was always monitored by an operator's SEP instructor who was responsible for recording any anomalies and reporting this to the operator's SEP Training Manager. Additionally, the SEP instructor was present at the 'signing-off' of the crew member's fire training certificates.

In summary, it appeared that if both the operator and the 'third-party' training organisation work closely together, the potential problems in respect of compatibility and consistency between the procedures in the operators' Operations/Training Manuals and the actual training provided, could be overcome. If such liaison does not occur then there is a real danger that there will be an inconsistency in the training and that the operator will not be able to ensure that their individual fire procedures have been effectively included in the training and that the required level of proficiency (as set out in JAR-OPS 1.1025) has been achieved.

The US training organisation evaluated in this study provides training based on the operator's approved training and operations manuals. The instructors have attended aircraft specific training with their airport fire department, and several instructors are part-time fire fighters.

2.10 **Single Cabin Crew Operations**

In one case, the single cabin crew operation firefighting procedure placed significant reliance on passengers, i.e. Able Bodied Persons (ABPs) providing the cabin crew member with assistance, including communication with the flight crew and providing any other assistance such as obtaining back-up firefighting equipment. Given that since the ABP would need to be briefed by the cabin crew member on their responsibilities, and that such a briefing would take some time to conduct, there would no doubt be a delay in initiating firefighting procedures.

In two cases, the emphasis was on landing the aeroplane as quickly as possible. However, the Cabin Crew Operations Manual of one operator detailed procedures for the accepted industry-wide 'ABC' firefighting procedure (i.e. Attack the fire, Back-up and Communicate). In a multi-cabin crew operation, these procedures would be carried out simultaneously. However, adopting these procedures in a single cabin crew operation would result in considerable delay in the flight crew being informed of the situation. Interestingly, during the practical training and contrary to the operator's Operations Manual, the 'third-party' instructors emphasised that communicating with the flight crew must be the first action.

In the case of one operator with both one and two cabin crew operations, there were no significant differences detailed in the firefighting procedures.

In one case, strong emphasis was placed on the flight crew landing the aeroplane as soon as possible as up to recently only short flights over land were operated. However, after discussion with the operator it was acknowledged that this would not necessarily be applicable to the recent expansion of the operation to European

destinations, and that a review together with amendments to the procedures might need to be considered.

The firefighting procedure for single cabin crew operations implemented by the US training organisation evaluated in this study particularly stresses the procedures for locating and fighting the fire, as well as breathing protection and passenger control. Depending on the operator's procedures, a typical procedure would be to have a passenger alert the cockpit as the cabin crew member combats the fire. Once the fire is controlled, they may elect to assign the extinguisher to a passenger (with instructions for use) allowing the cabin attendant to report to the cockpit. The fire fighting procedures and commands are reviewed in the classroom prior to training exercises conducted in the motion-based cabin mock-up. This is followed by scenario training in the "fire trainer".

2.11 Cabin Crew Clothing

It was noticed that in almost all of the cases, the fire training was conducted with the cabin crew wearing casual attire. Very few training sessions required the cabin crew member to wear a uniform, jewellery or a hair style, representative of that required by the operator when working on board the aeroplane. There may be good reasons for this, including the effects of smoke on an 'operational' uniform and the fact that some new entrant cabin crew may not have been issued a uniform at this stage and may have little awareness of the operator's requirements for hair styles and jewellery.

Theoretical PBE training often included the problems that female cabin crew might experience when donning PBE if wearing jewellery and/or glasses, but the issue of uniforms was not addressed. In the case of female cabin crew, particular problems that could be encountered when using PBE with regard to different hair styles were mentioned; however these were not replicated during practical training.

Operators should consider the issues of cabin crew uniforms, jewellery and hair styles, and any other factor likely to affect the ability of cabin crew to react rapidly to an in-flight fire and in particular, potential problems that could be encountered when donning PBE.

2.12 Conclusions – Review of Cabin Crew Fire Training Programmes

Adequacy of training in relation to JAR-OPS 1

- 1 The differences identified in training, especially the practical training, differed significantly amongst operators, in terms of the duration of training, the frequency of training, the training equipment used (both Halon extinguishers and PBE), fire scenarios, and smoke-filled environments. It is likely that such differences result from the requirements of JAR-OPS 1 not being sufficiently detailed and that both operators and 'third-party' training organisations are not exactly clear as to the best way to meet an acceptable standard.
- 2 Most operators included more training than was required by JAR-OPS 1, and this was especially the case for Recurrent Training. This might indicate the need for further consideration being given to the sufficiency of the requirements of JAR-OPS 1.
- 3 The differences in the practical fire extinguisher training and practical PBE training, that were observed, might indicate the need for further consideration being given to specific training requirements being included in future European aviation requirements.
- 4 JAR-OPS 1 provides no criteria in respect of what should be expected in terms of demonstrating proficiency in relation to fire extinguisher and PBE training and therefore such criteria are left to individual operators and national aviation authorities to determine.

- 5 JAR-OPS 1 provides only minimum requirements for fire training, with no advisory material available to assist operators in the developing of their fire training. Operators had to rely on their own experiences and standards, which differ amongst operators, leading to the differences in fire training identified in this study.

Adequacy of training

- 6 An in-flight fire demands that the flight crew and the cabin crew act as a team as rapidly as possible to deal with the situation. Given the little time that both the flight crew and the cabin crew may have to respond effectively to the threat, it would seem reasonable that consideration should be given to placing more emphasis on joint training, which could also include many CRM elements, as required by JAR-OPS 1. In most cases, the cabin crew were not made aware of the high-level of flight crew workload at such a time with the flight crew planning for a diversion and emergency landing.
- 7 Given the significant differences that exist between fire extinguishers (including their extinguishing agent) used in training and those installed on aeroplanes, consideration should be given to emphasising these differences during all fire training. This is also the case for the differences between PBE training units and live PBE.
- 8 The only part of the procedure for using PBE that is practised is the actual donning of the PBE and this is usually conducted on training units that are fully ready and in a condition that is not representative of the actual units. Consideration should be given to include removing PBE from its packaging in practical training and providing a standard for PBE training units.
- 9 It is likely that the current procedures used in training are not able to demonstrate to cabin crew the characteristics of Halon and its effectiveness in dealing with an in-flight fire. The use of a Halon extinguisher charged with water to fight a small scale fire does not provide a realistic method for the cabin crew to gain experience of Halon discharge, the way that it reacts with fire and its fire extinguishing effectiveness. Although there are aviation fire training video media available, none of them adequately addresses the specifics of how Halon actually interacts with fire. A training video that specifically addresses these issues might be of benefit.
- 10 The ease in which most of the fires encountered in training were extinguished is likely to lead cabin crew to a false sense of security or confidence. This may detract from the urgency of the situation and that such threats must be dealt with immediately and aggressively.
- 11 In one case, the necessity of speed in donning PBE was stressed with cabin crew having to achieve this in 15 seconds. This was timed on an individual basis using a stopwatch. Whilst this achieved a sense of urgency, not elsewhere observed in practical training, the exercise still remained unrealistic as the PBE training units were immediately 'at hand' rather than in the PBE stowages, and were disproportionately easy to don due to the poor state of the neck seals.
- 12 In some cases, when one cabin crew member was dealing with a fire scenario they were observed by other cabin crew, whilst in other cases they were not. Such observation of each other's performance is a useful learning tool and consideration should be given to encouraging this practice.
- 13 In some cases, when one cabin crew member was dealing with a fire scenario they were observed by other cabin crew, whilst in other cases they were not. Such observation of each other's performance is a useful learning tool and consideration should be given to encouraging this practice.

- 14 Whilst the urgency of an in-flight fire situation is included in some Initial Training, for Conversion and Differences Training and Recurrent Training, real scenarios are not always used effectively. The use of information from accidents and incidents to demonstrate the development of in-flight fires, and the consequential time available to deal with them effectively, might be one way of providing a better level of training.
- 15 Consideration needs to be given as to whether for single cabin crew operations, only one cabin crew member can effectively fight an in-flight fire, communicate essential information to the flight crew, obtain back-up firefighting equipment and deal with passenger management.

Crash Axe/Crowbar

- 16 It was observed that there is an issue concerning the lack of a crash axe or crowbar on aeroplanes with less than 200 passenger seats relating to the locked flight deck door. For aeroplanes with less than 200 passenger seats installed, the only required crash axe or crowbar is stowed on the flight deck and hence there could be a further time delay in accessing this equipment which might be detrimental to dealing with a hidden fire in the cabin. In such cases, consideration should be given to providing a light-weight crowbar in the cabin.

Interface between operators and 'third-party' training organisations

- 17 In some cases, obvious problems were identified in the consistency between some operators' procedures (i.e. as contained in their Operations and Training Manuals) and the training delivered by 'third-party' training organisations. However, there were at least two examples as to how such difficulties could be overcome, if addressed effectively by both parties.

Cabin crew clothing

- 18 It was not possible to ascertain if the uniform, jewellery and hair styles worn during cabin crew operations were compatible with practical fire training and in particular, the donning of PBE.

3 Online Cabin Crew Fire Training Survey

An online survey was constructed via a dedicated web page contained on the RGW Cherry & Associates Limited website. The survey invited cabin crew, flight crew and safety trainers as well as any other interested parties to comment on any perceived deficiencies in fire training and make suggestions as to their improvement. The survey was also intended to gauge participants' perception of their firefighting training and record any problems that might have been encountered by those who had been involved in fighting an in-flight fire.

The survey was publicised through:

- A UK CAA Press Release
- A UK CAA FODCOM 31/2007
- The Fifth Triennial Fire and Cabin Safety Research Conference, 29 October - 1 November 2007, in Atlantic City, New Jersey, USA
- The Aviation Safety Network Website
- Aircrew Magazine
- The International Transport Workers Federation
- The UK Cabin Safety Liaison Group
- Amicus (Trades Union)
- The British Airlines Stewards and Stewardesses Association (BASSA)
- Southern California Safety Institute (SCSI)
- The Cabin Safety Research Technical Group (FAA, UK CAA, Transport Canada Civil Aviation (TCCA) and the Australian, Brazilian, Russian and Japanese Airworthiness Authorities)
- The European Research Co-ordination Group (French, German, Dutch, Italian, Spanish and Swedish Authorities)
- The Air Transport Association of Canada
- Two cabin crew unions in Canada and
- The Civil Aviation Training magazine website

The study analysed the responses collected from 19 October 2007 to 13 January 2008.

The survey form is attached as Appendix 1 of this report. Questions 1, 2, 3, 6, and 9 solicit background information that was used in conjunction with other questions.

Questions 7, 8, and 11 were rating scale type questions, which asked respondents the degree to which they agree with the statements (Strongly Disagree, Disagree, Neutral, Agree, and Strongly Agree). There were thirteen statements in total; five statements were related to the adequacy and content of fire training, five statements were related to the realism of the practical fire training, and three statements were related to procedures taught in fire training.

For rating scale questions, the analysis was conducted by calculating the rating average. Values were assigned to each answer as follows:

Strongly Disagree = -2

Disagree = -1

Neutral = 0

Agree = 1

Strongly Agree = 2

The rating average was calculated as the weighted average of the responses. Where ratings were grouped, (e.g. those with firefighting experience v those with no firefighting experience) the rating average of a group's responses to a statement gave an indication of the overall attitude/perception of the group towards the statement.

Questions 4, 5 and 10 investigated respondents' opinions on the amount of time spent on theoretical and practical training and the problems encountered in dealing with an in-flight fire. Respondents had the opportunity to submit their comments on most of the questions, and they also had the opportunity to make suggestions to improve current fire training in Question 12.

It should be noted that comments featured in this report were selected to highlight fire training issues raised by respondents and to give examples of their suggestions for improvements to that training.

3.1 Number of Responses Received

Of the 2612 respondents who started the survey, 2164 completed it (82.8%). The responses received were from 66 countries across Europe, Asia Pacific, Africa, North America, and South America.

Figure 1 shows the number of responses received based on country of organisation and occupation.

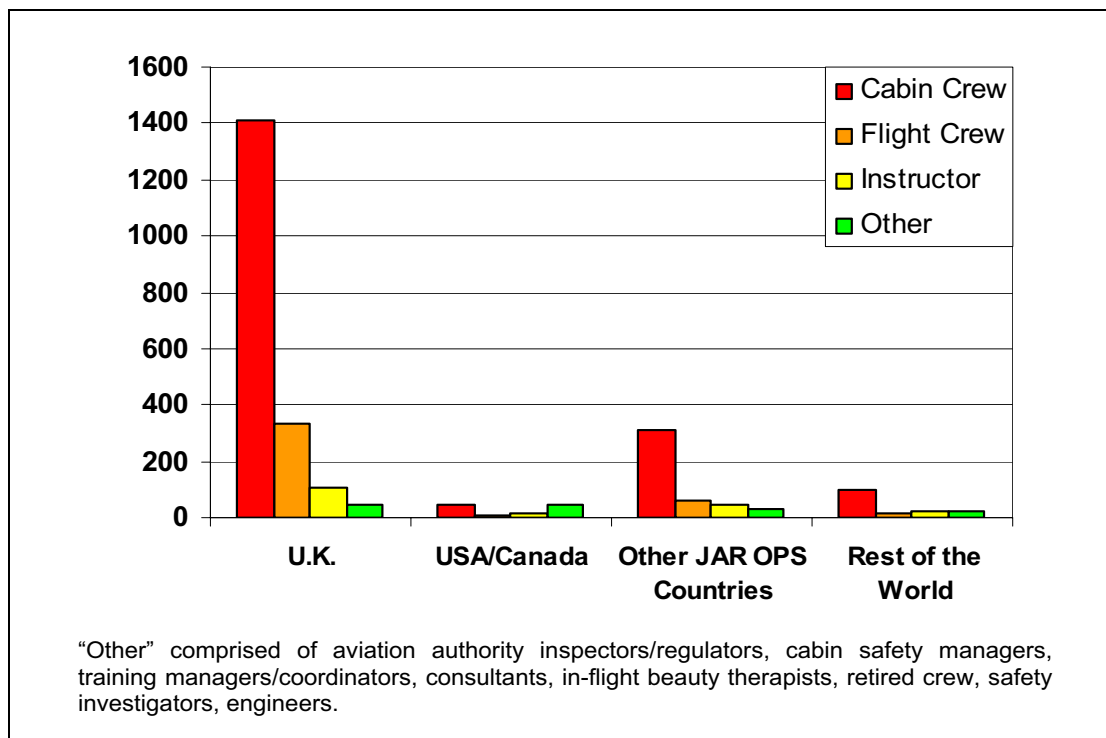


Figure 1 Number of Responses Received

As self-selected respondents, the results were likely to have a bias with those having strong views more likely to respond than those who were less concerned. This was because inevitably many of the questions required answers that may be very dependent on the respondents' company practice. Although the survey was promoted through various means, it was not possible to ensure that the responses are representative of all UK operators since participation in the survey was voluntary.

Comparison with other countries or groups of countries was also problematic, as the promulgation of the survey appeared to be more widespread in some countries than others. For example, of the 444 responses submitted from "Other JAR OPS Countries", 68.5% were contributed by only three countries, i.e. Portugal (124), Ireland (116), and Switzerland (64), whilst the rest span a further 23 JAA countries.

Additionally, it was also possible that the promulgation of the survey was more widespread amongst certain occupations within a country. This was quite evident in the responses from USA/Canada, where 38% of the responses received were categorised as "Other" occupation – half of which were Cabin Safety Inspectors/Regulators. This was very high compared to 2% of respondents categorised as "Other" occupation in the UK, 7% in Other JAR OPS Countries, and 15% in the Rest of the World.

The responses analysed in detail were limited to those from the UK. However, valuable suggestions on subjects, not covered in other sections, as discussed in Section 3.13, have also been included from respondents outside of the UK.

3.2 Respondents' Experience With In-flight Fire

Respondents were asked if they had been involved in fighting an in-flight fire, witnessed an in-flight fire, or had no experience with an in-flight fire (the UK response is shown in Figure 2). This information was used to group the responses from those who had some kind of experience with an in-flight fire (i.e. witnessed or involved in fighting an in-flight fire) and those who had no experience with in-flight fire. .

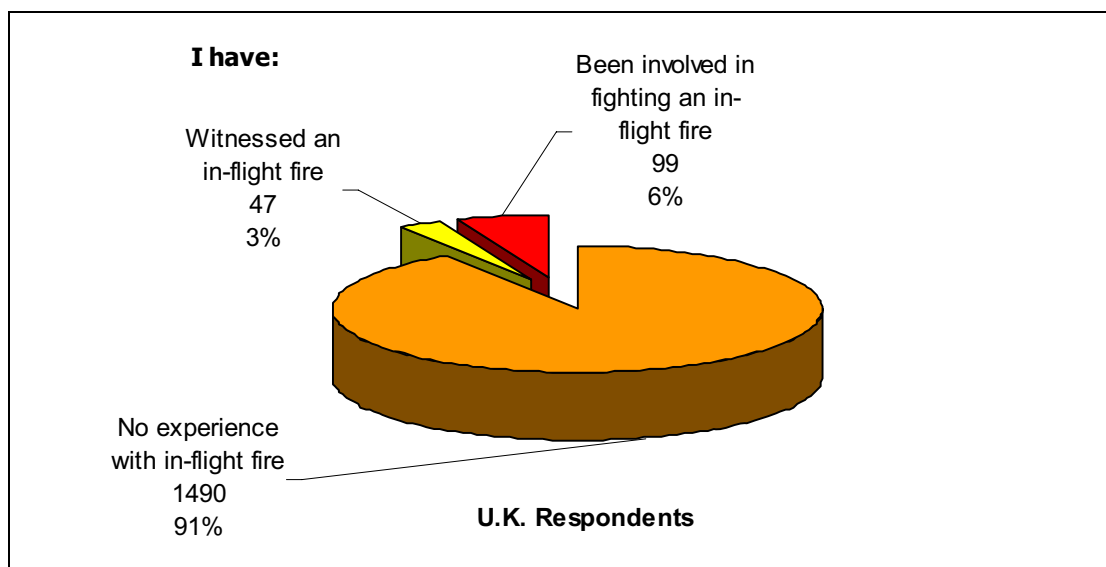


Figure 2 UK Respondents' Experience with In-Flight Fire

3.3 Duration of Fire Training

3.3.1 Duration of theoretical training



Figure 3 UK Respondents' Perception on the Amount of Time Spent on Theoretical Fire Training

The majority of UK respondents (84.4% of respondents without any in-flight fire experience and 73.3% of respondents with in-flight fire experience) felt that the amount of time spent on theoretical training was sufficient (see Figure 3).

There was a higher proportion of respondents with in-flight fire experience who felt that the duration of theoretical fire training was too short (20.5% compared to 12.7% respondents without in-flight fire experience).

However, 5.5% of respondents with in-flight fire experience felt that the theoretical training was too long; compared to the 1.9% from respondents without fire experience. It is possible that the respondents with in-flight fire experience in this case felt that increasing the time spent on practical training would be more beneficial for them (7 out of 8 of these respondents felt that their practical training was too short).

From the comments received on the subject, it appeared that many UK respondents found theoretical fire training in Initial Training sufficient in both duration and content. Some respondents expressed their concern on the lack (or absence) of theoretical training in Recurrent Training (note: currently there is no requirement in JAR-OPS 1 to include theoretical fire training in Recurrent Training).

"No mention of it in Recurrent Training..." (Cabin Crew – UK)

"The theory of fire fighting is only covered in Initial Training..." (Cabin Crew – UK)

"The initial fire training does go into depth, however Recurrent Training does not go into much detail..." (Cabin Crew – UK)

"I believe that the [theoretical] training, when given, is sufficient, but is forgotten quickly so there should be more refreshers." (Flight Crew – UK)

"Initial Training – sufficient. Recurrent Training - not enough time spent on theory." (Instructor – UK)

Some respondents suggested including more discussion on actual accidents/incidents to further trainees' understanding:

"A little more theoretical training, maybe up to 15-30mins per annual safety day would be helpful. Maybe highlighting an incident & discussing better ways of dealing with it on the day." (Flight Crew – UK)

"Much more technical and actual incident feedback would be most helpful." (Flight Crew – UK)

"Would like to have more discussion about real events and possibly see videos of true events..." (Cabin Crew – UK)

3.3.2 Duration of practical training



Figure 4 UK Respondents' Perception on the Amount of Time Spent on Practical Fire Training

On the duration of practical training, 41.4% of respondents without in-flight fire experience felt that it was too short, 56.4% felt that it was sufficient, and 1.5% felt that it was too long.

A higher proportion of respondents with in-flight fire experience felt that the duration of practical training was too short (51.4%), whereas 45.9% felt that it was sufficient, and 2.7% felt that it was too long.

The following were some of the comments made by respondents who felt that the duration of practical training was too short:

"I feel at the airline I work for that the fire training practicals are rushed (this is on Recurrent Training). When we were last in the fire rig, it was more or less a case of point a BCF at a fire and the fire would automatically disappear (as it was controlled by a gas tap). This could give the false impression that a REAL fire would disappear that quickly in a real emergency. More emphasis needs to be put into practical training, even if this means extending Recurrent Training by a day!" (Cabin Crew – UK)

"I believe fire/smoke training is a highly practical skill that requires extensive practice. Over many years I have seen inadequate course lengths, sometimes caused by crew scheduling slots, and sometimes due to the crew wishing to complete their refresher training as fast as practicable." (Instructor – UK)

"I think the theory part of fire training in [...] is good and adequate, but the practical side is very poor. Generally, for all companies, the cabin crew and flight crew should have more practice on to how to tackle a fire. Training should take longer for the practice than for the theory." (Cabin Crew – UK)

Some respondents commented on the minimal time dedicated to individual trainees during practical training, which was mainly due to large class sizes:

"Not enough time is focused on each individual, we do group practical exercises but not enough time is spent on making sure we all know what we are doing..." (Cabin Crew – UK)

"More practical training in groups much smaller so that everyone can get sufficient feedback. Often this type of training is done in much bigger groups where it is difficult for anyone to give or receive feedback." (Cabin Crew – UK)

"The fire training given is very vague and rushed. The practical drills are excellent, but too rushed and not enough time is given to individuals." (Instructor – UK)

"In my experience of three Initial Training courses, you get to put out one fire per person because class sizes are so large, that you barely get time in the simulator to do anything more. Trainers are put under stress from both the class and management to get everyone through, that the actual time you get to physically deal with these situations is extremely limited." (Cabin Crew – UK)

"It would be very helpful if there would be less people in each training and more time and different scenarios dedicated to these people." (Cabin Crew – UK)

There were many comments on the content of the practical training, which are discussed in the relevant parts of Sections 3.4, 3.5 and 3.6.

3.4 Adequacy of Training

3.4.1 Training for fire behind cabin panels

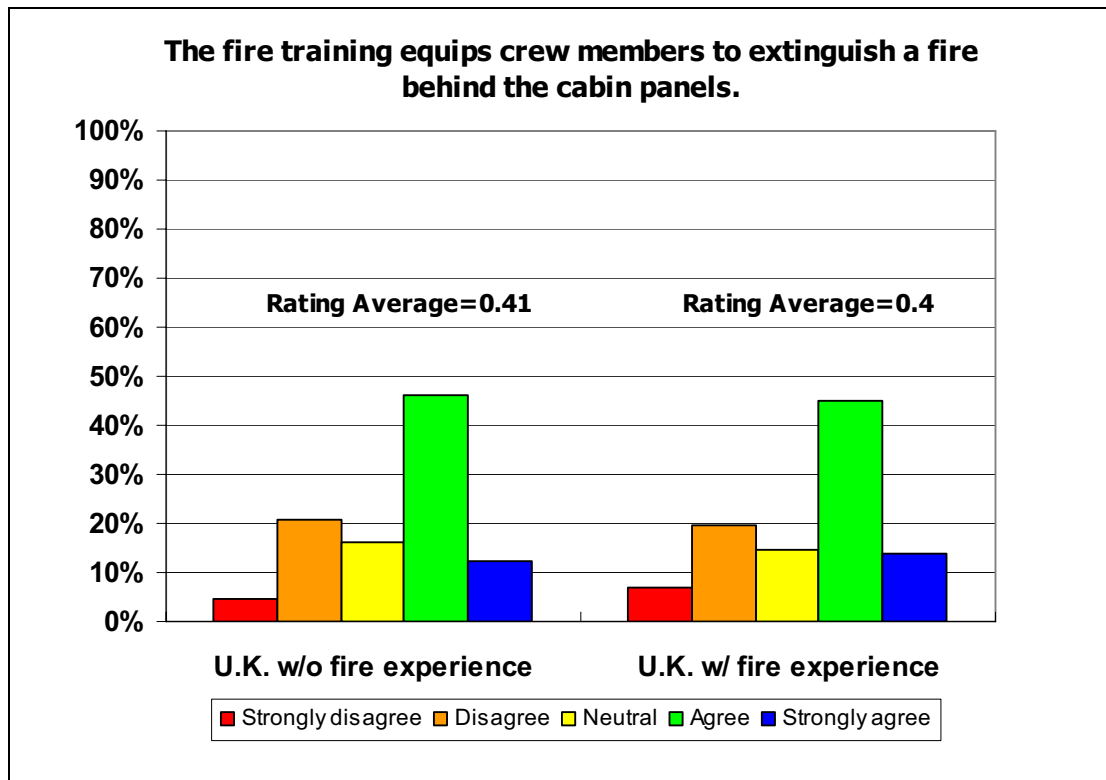


Figure 5 UK Respondents' Attitude on the Adequacy of Training for Fire Behind Cabin Panels

As can be seen in Figure 5, both groups (with and without fire experience) exhibited similar overall attitudes towards the adequacy of training for fire behind panels (hidden fires).

The rating averages of 0.41 and 0.40 did not demonstrate a particularly "strong" overall positive attitude, which was likely due to the differences in training practices amongst operators/training organisations. Respondents who answered "Strongly agree" were most likely to have had some practical training for hidden fires, as indicated by the following comments:

"We were given an opportunity to use a crash axe on a section of an aircraft to establish how much force would be needed." (Cabin Crew – UK)

"I was glad to be given the opportunity to hold and use a Crash Axe which was a first in 20 years!" (Cabin Crew – UK)

Meanwhile, most respondents who answered "Neutral", "Disagree", or "Strongly disagree" commented that they received theoretical training but not practical training, or that the practical training was not adequate:

"In 11 years I have never done any practical exercise which involved pulling out a panel with a jemmy [crowbar]. Practicals seem to centre around toilet & oven fires. I think our practical training for these types of fires is good but fires behind panels are covered theoretically only." (Cabin Crew – UK)

"Concealed fire training was just talked through – came away not feeling confident in that..." (Cabin Crew – UK)

"The training only covers the topic of fighting fires behind panels, it would be good to have a practical exercise, as this would then also show crew how to safely use a crash axe too!" (Cabin Crew – UK)

"During training crew are not taught enough about what is behind each panel, which could in turn lead to more problems if the wrong panel or piece of equipment is used in the wrong area." (Cabin Crew – UK)

"I think the practical training should be more extensive. It is true that we get told by the trainers and it's written in our manuals about extinguishing fires behind panels etc. but we should be given opportunity to use the axe for instance (behind panels)." (Cabin Crew – UK)

"There is only a weak point where I could do with a bit more training, which is smoke/fire behind cabin panels. I really don't know what is there behind those panels. If there was a fire/smoke behind those panels and I couldn't put it off following the standard procedures in the manuals, I wouldn't know what to do." (Cabin Crew – UK)

3.4.2 Training for simultaneous, multiple fires

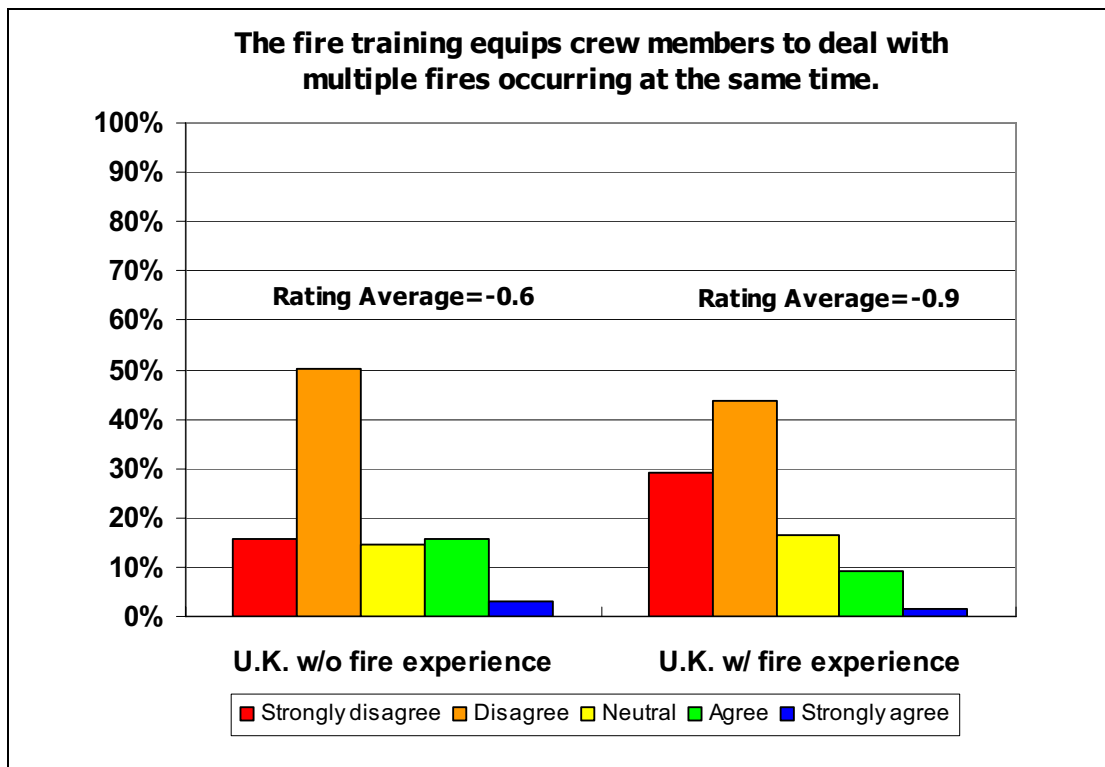


Figure 6 UK Respondents' Attitude on the Adequacy of Training for Simultaneous, Multiple Fires

Both groups indicated an overall negative attitude towards the adequacy of training for simultaneous, multiple fires. The respondents with in-flight fire experience revealed a more negative attitude (rating average of -0.90) than those without in-flight fire experience (rating average of -0.60).

Many respondents commenting on this subject stated they had never had any training for multiple fires. Some respondents stated they had not even thought of the possibility of such an occurrence, but suggested that there should be some kind of training or guidelines in place for it:

"I've never carried out an exercise where we have fought multiple fires - this would be a good idea. It would show how important teamwork and managing that situation would have to be. Would like to see that happen." (Cabin Crew – UK)

"I have never been trained on multiple fire scenarios... it's always trained in the "perfect fire" scenario where you have enough BCF's, fire always goes out and you have no passenger panic." (Cabin Crew – UK)

"We only ever train if there was to be one fire on board. There should be a procedure in place for multi fire situations. If what if not enough crew to fight the second fire??" (Instructor – UK)

Some respondents expressed their concern on the event of multiple fires relating to the in-flight fire procedure that incorporates three roles of the cabin crew (i.e. Firefighter, Assistant Firefighter/Coordinator, and Communicator, also known as the 'ABC' procedure for 'Attack – Backup – Communicate'). The comments received on the subject of a small crew complement in relation to the 3-crew firefighting procedure indicated that some cabin crew regard the procedure as a "hard and fast" procedure:

"Our fire drill involves 3 crew, so in the eventuality of a multiple fire situation, it is not laid out who should do what!" (Cabin Crew – UK)

"No training for multiple fires at the same time onboard. This should also take into account the minimum crew on board the aircraft as this could be as little as four crew. Four crew with two fires no guidelines exist." (Cabin Crew – UK)

3.4.3 **Training for any fire visible in the cabin**

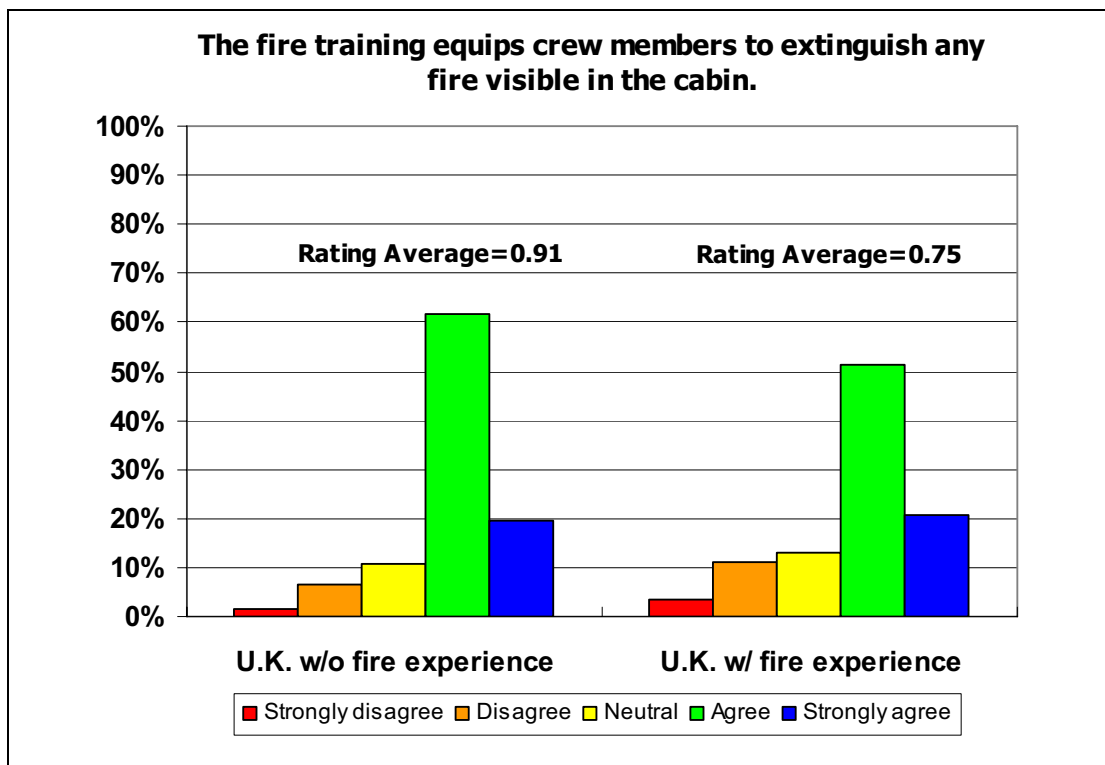


Figure 7 UK Respondents' Attitude on the Adequacy of Training for Fire Visible in the Cabin

Based on the rating averages, the survey results suggested that UK respondents with and without in-flight fire experience exhibited an overall positive attitude towards the adequacy of the training for fires visible in the cabin. As also evident in other questions, respondents with in-flight fire experience had a less positive overall attitude than respondents without in-flight fire experience.

Comments submitted by respondents who answered “Strongly disagree” or “Disagree” on this subject were mostly related to their perception of the general inadequacy of their fire training (e.g. training equipment and facilities, lack of standards in demonstrating proficiency – which are discussed in separate sections) and the minimal types of fire practiced:

“Concentration is mainly on the distinguishing of toilet and oven fires. Aircraft panels and electrical fires are only discussed in the theoretical side of fire training, yet we as cabin crew are taught that a fire on board an aircraft could result in a catastrophic situation. All fires need to be fully covered – not simply showing cabin crew how to open a toilet door if a suspected fire is behind it!!”
(Cabin Crew – UK)

Even respondents who displayed a positive attitude to this subject still had the opinion that more types of fires should be practiced on, in particular IFE fires and lithium battery fires:

“There isn't much time to go through all fire scenarios so only one-two are chosen and specialised in. The more unlikely fire situations are always an eye opener and I always learn a lot from. Would be more useful for a lot more scenarios/situations.” (Cabin Crew – UK)

“We look at dealing with fires in ovens, toilets (waste bin at present) & overhead lockers. It may also be useful to look at situations such as waste bins/waste bags, baggage in cabin, IFE systems, Flight Deck and seat cushions. Perhaps alternate each year with different scenarios...” (Instructor – UK)

“...one type of fire that could be practiced is how to deal with lithium battery fires as more and more people are carrying these onboard our aircraft and there is no practical training done on this, we just spend 5 minutes doing theory.”
(Cabin Crew – UK)

“No mention in training about seat, in-seat IFE or battery fires from I-pods computers etc.. This is however covered thankfully in our SEP manuals.” (Cabin Crew – UK)

“Fires inside the A/C do not just happen in toilets and galleys, with the introduction of IFE and the greater loading of the A/C systems, few crew understand the implications.” (Instructor – UK)

“... a lot of people don't seem to be familiar with power isolation, of IFE and also galley power.” (Cabin Crew – UK)

There were many comments on the deficiencies perceived by respondents relating to training facilities and training equipment in the UK, which are discussed in the relevant parts of Section 3.5.

3.4.4 Training for management of passengers

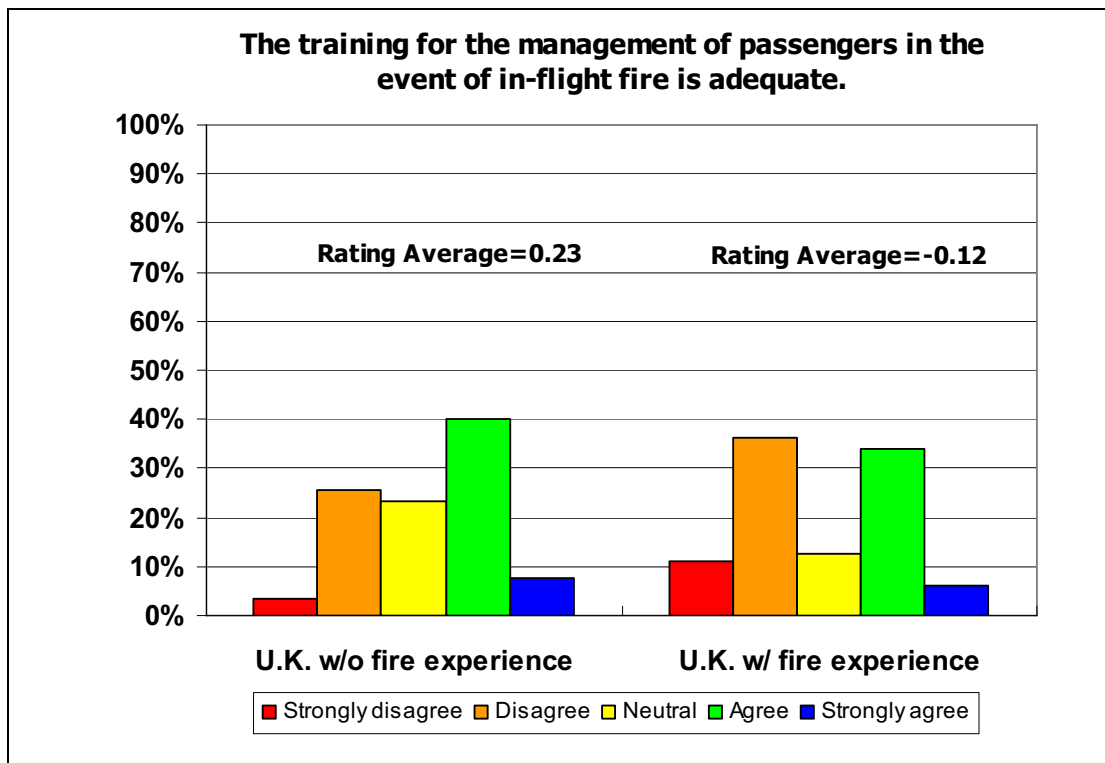


Figure 8 UK Respondents' Attitude on the Adequacy of Training for Management of Passengers

UK respondents without in-flight fire experience were somewhat positive on the adequacy of training for management of passengers whereas UK respondents with in-flight fire experience were more negative. There appeared to be a polarity in both groups, more apparent in the group with in-flight fire experience, which contributed to the "weak" rating averages (i.e. not demonstrating a strong positive or a strong negative overall attitude). This might have been caused by the different training practices amongst operators/training organisations, or the different perception of how "adequate" the training for passenger management could be, considering the many variables involved. The latter was reflected in some comments, for example:

"No amount of training can prepare you for passenger reactions and management because no one can predict how people will react. Every situation will be different. But the basic principles are instilled well..." (Cabin Crew – UK) – Neutral; no experience with in-flight fire

"We are obviously trained quite well to deal with fires, but if one was to happen onboard there is no certainty to how crew and passengers would react. So even though we are trained in the management of pax, it may be difficult if we have most of the plane screaming, if hardly any of the pax talks English and starts to panic-we can only do our best in these sorts of situations and act on initiative." (Cabin Crew – UK) – Agree; no experience with in-flight fire

"Having been in emergency situations onboard in the past, the scariest being a smoke filled cabin after take-off MEL-SYD on [...]. Training for the management of passengers & different fires can only do so much, on the day you will have different personalities onboard, different percentages of people who fight or fly etc., etc. You need knowledge & confidence to make a split decision given what is around you on the day. It is impossible to be trained for every different

scenario possible. I have had two decompressions and both panned out very differently.” (Cabin Crew – UK) – Neutral; have been involved in in-flight smoke event

UK respondents with and without in-flight fire experience that answered “Disagree” or “Strongly disagree” mostly stated that they never received any training for passenger management, or that the training was not sufficient:

“There are very few drills in a training scenario that actually involve dealing with a large number of passengers...” (Cabin Crew – UK) – Disagree; have been involved in fighting in-flight fire

“Practical training involving a cabin with passenger reactions and having to properly move passengers and equipment would be useful...” (Cabin Crew/ Line Trainer – UK) – Disagree; have been involved in fighting in-flight fire

“Passenger control needs to be focussed on more as this was not really dealt with sufficiently in training.” (Cabin Crew – UK) – Disagree; no experience with in-flight fire

“... re. management of passengers, our procedures has one crew member dedicated to this amongst other responsibilities. However the actual detail in training of how to manage passengers in a fire situation is very vague. It is assumed you would use your common sense, by asking them to 'move away from the area', 'put heads down low', 'breathe through seat covers', etc” (Cabin Crew – UK) – Disagree; no experience with in-flight fire

“There should be more time spent on passenger control during an in-flight fire. More background knowledge could be transmitted regarding crowd panic and how to deal with it.” (Cabin Crew – UK) – Disagree; no experience with in-flight fire

It is likely that the problem with delivering this type of training was in simulating the situation, i.e. the availability of a large group of “passengers” and the unpredictability of their reactions. A respondent suggested using volunteers such as school children on a day trip; but this might involve some Health & Safety issues. Another respondent suggested carrying out training in larger groups who could then act as passengers; however, training in larger groups presents other problems as previously discussed in Section 3.3.2.

Problems in managing passengers accounted for 7% of the problems encountered when dealing with in-flight fire/smoke reported in the survey by UK respondents (see Section 3.7 Problems Encountered During Firefighting).

3.4.5 **Adequacy of the frequency of practical fire training**

Respondents were asked to indicate the degree to which they agreed with the statement “The time between practical fire training is such that crew members remember everything taught in the training within that period.” This was used to investigate respondents’ perception of the adequacy of the interval between their practical fire training.

Although JAR-OPS 1 requires practical recurrent fire training at intervals not exceeding three years, some UK operators have introduced practical recurrent fire training every year and some every 2 years. The respondents were asked about the frequency of their practical fire training (UK responses shown in Figure 9); this

information was then used in conjunction with their perception of how adequate that frequency was (shown in Figure 10 and Figure 11).

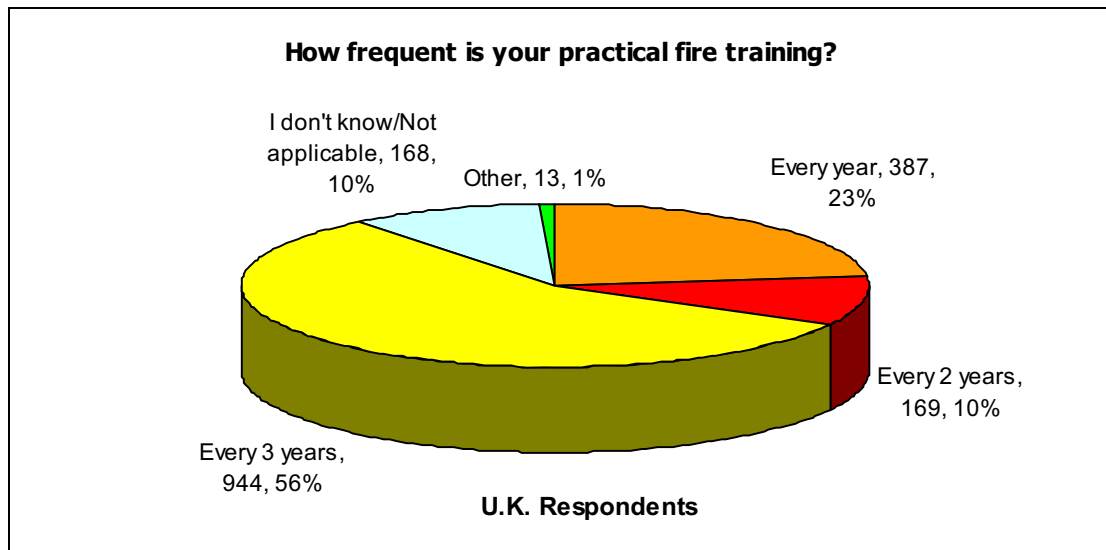


Figure 9 UK Respondents' Frequency of Practical Fire Training

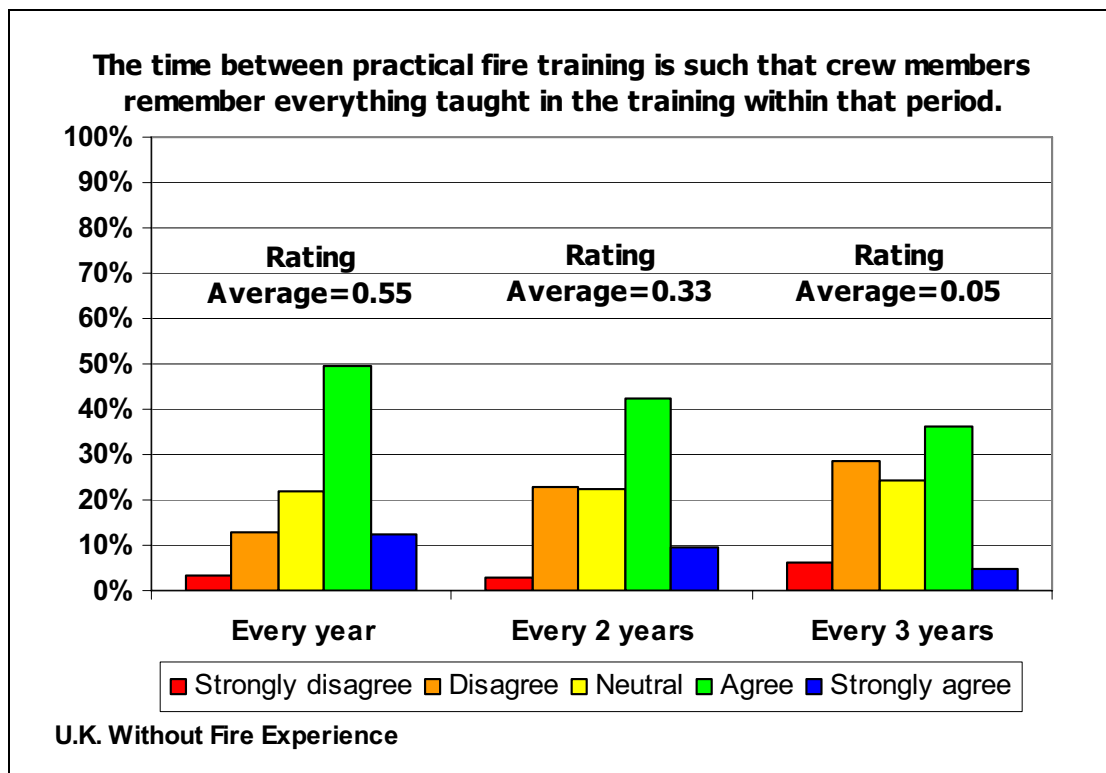


Figure 10 UK Respondents (Without In-flight Fire Experience) Attitude towards Frequency of Practical Fire Training

As shown in Figure 10, UK respondents (without in-flight fire experience) who had annual practical training showed a more positive overall attitude towards the adequacy of the frequency of practical fire training (rating average of 0.55). This attitude was less positive in the groups with longer intervals; respondents with 2-

yearly practical training had a rating average of 0.33 and respondents with 3-yearly practical training had 0.05.

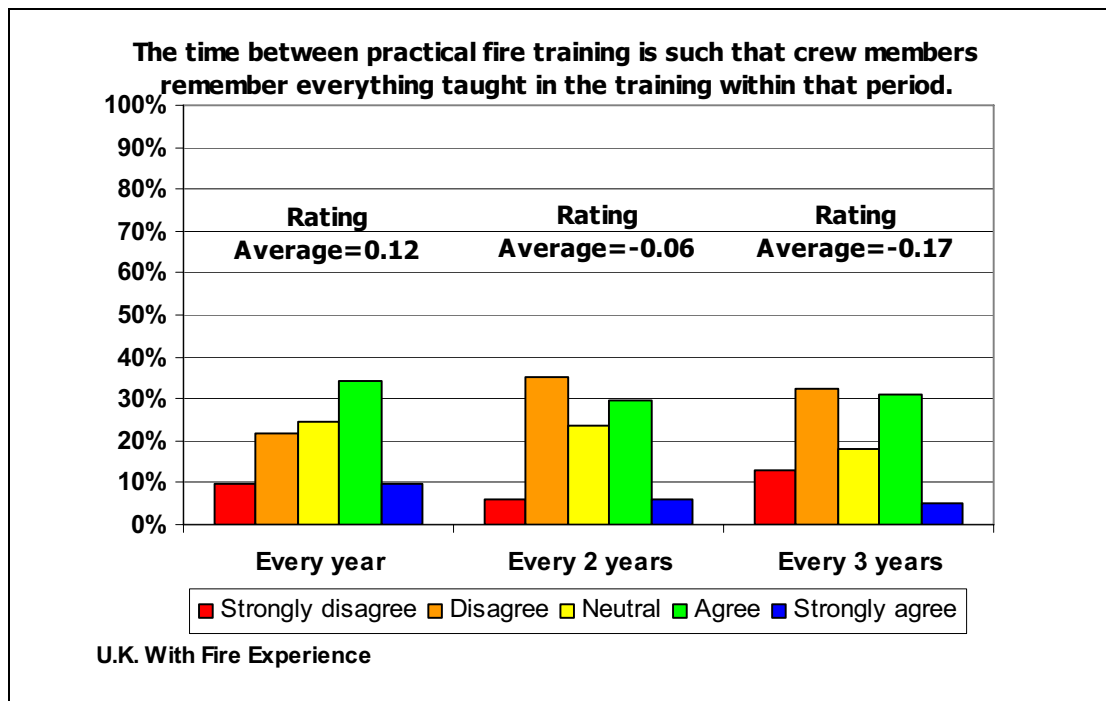


Figure 11 UK Respondents (With In-flight Fire Experience) Attitude towards Frequency of Practical Fire Training

Similar to those who had not experienced in-flight fires, the respondents with in-flight fire experience who had annual practical training displayed a more positive overall attitude towards the adequacy of the frequency of their practical training compared to those who had 2-yearly or 3-yearly practical training. In this case, the two latter groups actually exhibited a negative attitude.

It is also apparent that overall, respondents with in-flight fire experience had a more negative attitude than respondents without in-flight fire experience.

It is evident that the maximum interval of three years for practical recurrent fire training, as stipulated by JAR-OPS 1, was perceived as the least sufficient interval:

"I think the time spent on Initial Training is sufficient but Recurrent Training every 3 years is too long a time. In my experience crews knowledge after a 3 year gap is not as good as I would like." (Instructor – UK)

"Initial Training is sufficient but you can never have enough practical training in this area, this is one of the most important parts of the training programme. Fire recurrent should be more frequent though, our company does it every 3 years but I think we should have an annual refresher." (Cabin Crew – UK)

"Briefly handling an extinguisher once a year, and squirting one every three years is insufficient to retain any practical skill - particularly when such ability is to be used under pressure." (Flight Crew – UK)

"As mentioned above, I feel that our initial practical training is A1. However, we would benefit from revisiting the practical every year when we have our Recurrent Training. For example, most of us have had a medical emergency

onboard at some point and could maybe have done things better the very first time we were exposed to the real life onboard experience, and the next time we experienced a real life medical emergency we are more comfortable as we have been exposed to all the natural feelings and events that unfold. The same can be argued for fire fighting, as the more we do it practically the better chance we would have given a real fire onboard an operational aircraft. I feel the training we received during our Initial Training is professional and well thought out and offers great experience... maybe the best there is, so revisiting this area might cost more, but would benefit everyone” (Cabin Crew – UK)

A suggestion was made on the possibility of having differing practical training frequencies depending on seniority:

“For newly qualified crew members, the capacity to remember all details would probably make a case for more frequent fire training in the first few years. Subsequently more experienced crew can maintain info, and the current 3yr period is adequate.” (Cabin Crew – UK)

3.5 Realism of Practical Fire Training

3.5.1 Realism of fire conditions during training

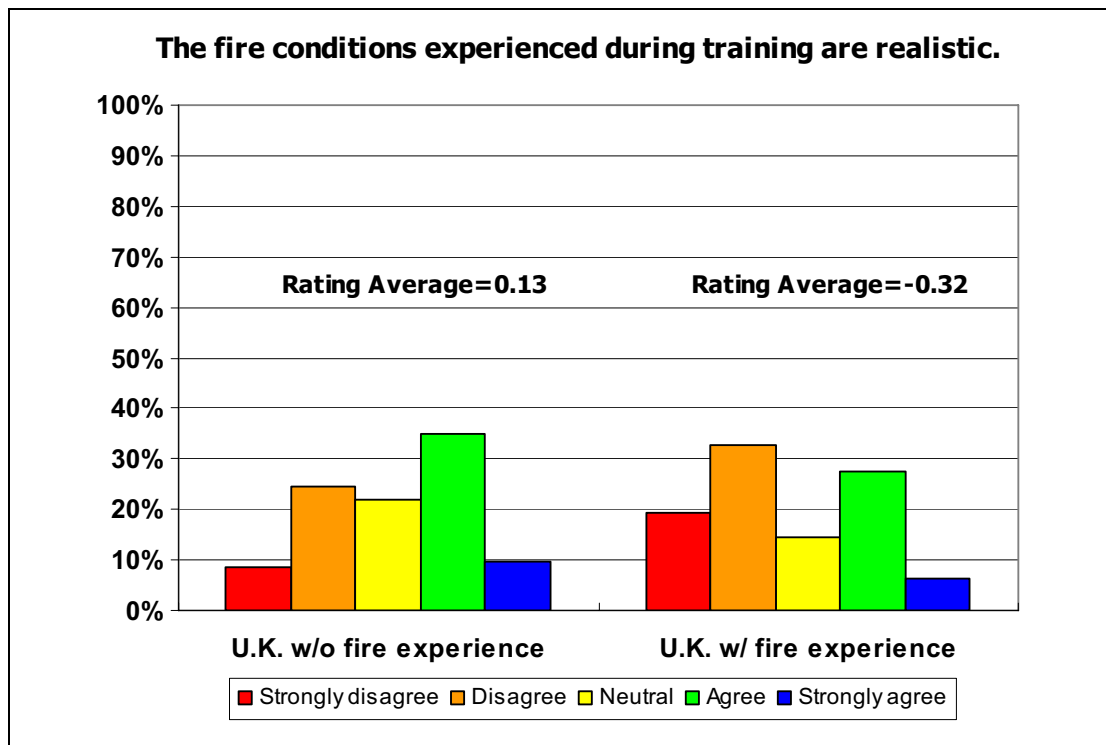


Figure 12 UK Respondents' Attitude on the Realism of Fire Conditions during Training

Respondents were asked about their perception on the realism of fire conditions during their practical training. This was obviously very dependent on their operator/training provider's training practice and facilities, which might contribute to the polarity of the responses seen in the distributions in Figure 12 (for UK responses).

Another aspect that might affect UK respondents' perception was their acknowledgment of the restrictions due to Health and Safety regulations, as reflected in the following comments:

"The magnitude of the fires is not particularly realistic due to health and safety restraints." (SEP Manager – UK) – Agree

"Simulating a fire can only go so far, for various reasons including health and safety and duty of care." (Training Manager – UK) – Agree

"The simulated fire and smoke conditions are as close as possible to real conditions without anybody being at risk. Good practise." (Cabin Crew – UK) – Agree

UK respondents without in-flight fire experience were somewhat positive on the realism of fire conditions during their training, whereas UK respondents with in-flight fire experience were more negative. However, regardless of their experience, respondents who answered "Strongly disagree" or "Disagree" appeared to share the same view on the inadequacy of the fire conditions during training:

"Smoke and searching is realistic but the actual fire fight is very unrealistic." (Flight Crew – UK) – Strongly disagree; have been involved in fighting in-flight fire

"Nothing about the practical training is realistic. In my previous job on the continent we had fight real oil fires and this with real CO2 or BCF. This made you realize the danger and the need the know what to do with the correct equipment. Unfortunately as I have been told real training will be too costly and too dangerous, so we will never be able to have a good standard in the UK. So let us concentrate on preventing instead of curing." (Flight Crew – UK) – Strongly disagree; no experience with in-flight fire

"The scenarios and equipment may be the same, but it doesn't mean that the training is GOOD ENOUGH for cabin crew to put out any fire apart from minor fires like oven and toilet bin and ONLY if the fire is small!!!" (Cabin Crew – UK) – Strongly disagree; no experience with in-flight fire

"Facilities are limited, but it is a little unrealistic to simulate a fire from an overhead locker with red/orange LEDs and lots of smoke. We have no appreciation of temperatures etc. and little use of 'genuine' equipment..." (Cabin Crew – UK) – Strongly disagree; have been involved in fighting in-flight fire

"... Health and safety regulations meant fire situation wasn't that realistic (fear of being sued... in case of injury). I feel in a real situation it would be much scarier for crew and I think we should be prepared for that during the practical training by being shown it, rather than to be told to imagine. I think crew would probably panic less in a real fire situation if they understood the importance of acting quickly and following drills..." (Cabin Crew – UK) – Disagree; no experience with in-flight fire

"The metal hollow ovens don't represent a proper fire to me; we don't ever experience the debris scattering that would occur with the use of BCF's during a real fire." (Cabin Crew – UK) – Disagree; no experience with in-flight fire

The use of gas-powered fires was of concern for many respondents, as reflected in the following comments:

"Practical fire training is incredibly unrealistic. Basically a gas barbecue simulating flames and poor simulation of BCF extinguishers don't help. Fire training needs to be putting out REAL fires with REAL extinguishers in REAL confined spaces in REAL cabin environments..." (Flight Crew – UK)

"The practical firefighting involves merely one squirt of water from the fire extinguisher onto a fire that is immediately extinguished by the instructor turning off the gas supply. The training is perfunctory and unrealistic; it seems designed merely to tick the appropriate boxes to maintain currency." (Flight Crew – UK)

"Fires are simulated during a gas fire which is turned off by trainers as soon as BCF pointed in the right direction. BCF filled with water which is hardly realistic. I know it would be impossible to use a real BCF or anything other than a gas fire but it doesn't prepare you for reality." (Cabin Crew – UK)

However, the use of gas-powered fires could be effective if there were systems or standards for instructors to which they could refer to when determining adequacy of extinguishment process:

"Many years ago I was shown and was most impressed by the very realistic and all moving cabin simulator in Dubai. This also had pretty good 'fires' and a good way of checking how they were tackled so that they would only 'go out' when the extinguisher was used and directed correctly. Is this type common now or still a rare example of a good simulator? Without such equipment training will be well short of ideal." (Instructor – UK)

Some respondents indicated that, based on their experience, there was an additional value in using extensive fires using combustible materials or flammable liquid:

"When real extinguishers were used in the past on real petrol/oil fires the exercise was not always successful (the fire did not go out). This taught candidates to use the extinguishers effectively and to recognise just how little we have on board." (Flight Crew/Instructor – UK) – Strongly disagree

"Nothing about the practical training is realistic. In my previous job on the continent we had to fight real oil fires and this was with real CO2 or BCF. This made you realise the danger and the need to know what to do with the correct equipment" (Flight Crew – UK), Strongly disagree

"When I started flying in 1991 we trained on airport with real fire and smoke and it was very realistic and gave you a real idea of how dangerous a cabin fire can be and how rapidly it can spread and how restricted your vision can be. We should have more realistic conditions. The harder you train the easier it is when it happens for real..." (Cabin Crew – UK) - Strongly disagree; no experience with in-flight fire

"In a previous company, fire extinguishing was practiced on a burning petrol "puddle" of about 1sqm and also on burning clothes/fabric soaked with flammable liquid, with actual airport firemen. Far more interesting and realistic than current company using an in-house "gas BBQ" mock-up type with in-house trainers. The latter might be better to train the procedures, but doesn't help in actual fire fighting technique (fire re-ignition and spread, spreading of burning material due to extinguisher blast, ...)" (Flight Crew – UK), Strongly disagree

"As someone who has attended 'proper' fire fighting training in a previous occupation I understand the necessity for all flight crew to attend (even if only once in Initial Training) a REAL fire fighting course run by one of the many fire fighting units around the country, preferably an airport unit. There really is nothing quite like the experience of fighting real fires with real extinguishing agents in confined places with all the heat and smoke that goes with it to truly appreciate the seriousness of a fire..." (Flight Crew – UK), Strongly disagree

3.5.2 Realism of smoke conditions during training

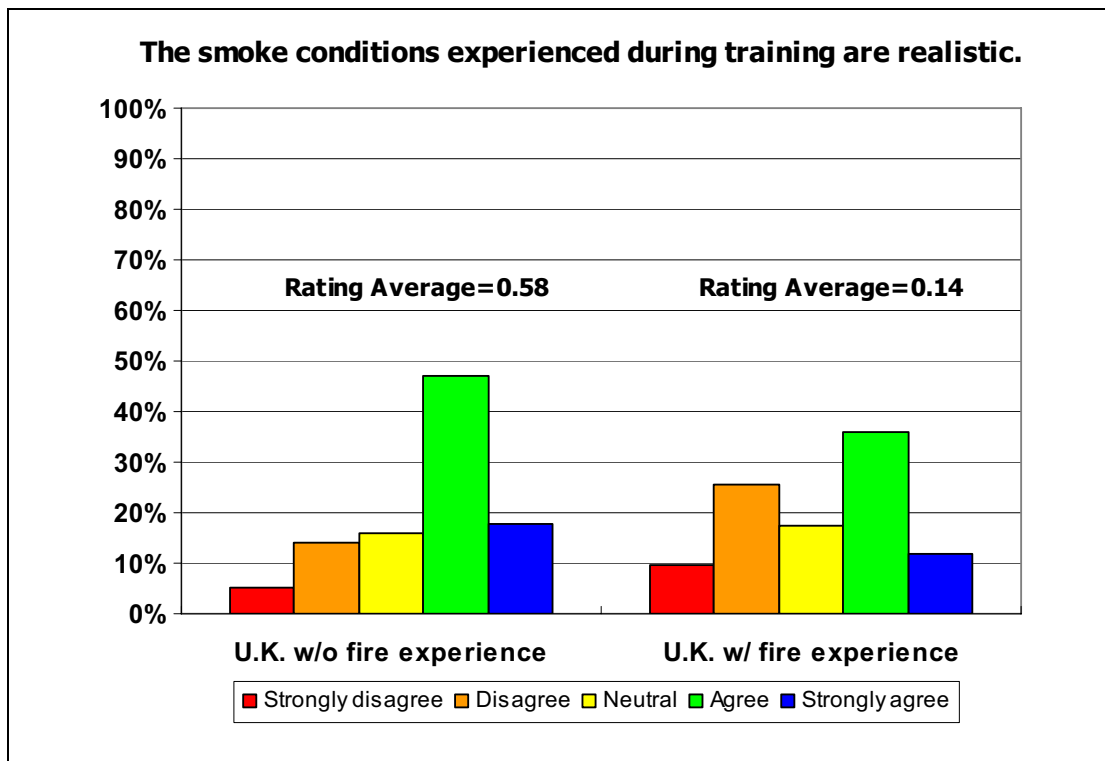


Figure 13 UK Respondents' Attitude on the Realism of Smoke Conditions during Training

Overall, the attitude of UK respondents on the realism of smoke conditions during training was positive. However, respondents with in-flight fire experience showed a less positive attitude than the respondents without in-flight fire experience.

Similar to the comments made on fire conditions during training, it appeared that the limitations related to Health and Safety regulations on smoke conditions during training were still of concern to some respondents. However, there appeared to be more tolerance of these limitations and generally respondents did not expect the training smoke to simulate all of the characteristics of actual smoke (nor that it is possible).

"Smoke conditions will never truly represent actual fire so that is why I have marked neutral. So although they are as realistic as we will be able to simulate i.e. - poor visibility I don't feel you can make "realistic" smoke conditions!" (Cabin Crew – UK) – Neutral; witnessed an in-flight fire

"You don't get to fully appreciate the seriousness, i.e. smoke density, heat and how ferocious fires can be, the flames and the height they can reach and how they can escalate quickly." (Cabin Crew – UK) – Neutral; witnessed an in-flight fire

Based on the comments received, the respondents' judgement of the realism of smoke conditions in training was primarily related to the level of visibility, condition of the smoke training facilities, and the scenarios in which smoke was used.

Generally, respondents considered light smoke conditions, which still allowed good visibility, as "not realistic", as reflected in the following comments:

"Smoke filled cabin was poor, you could see where you were going, I feel if we have to be in a smoke filled cabin make it worse, so we can't see....." (Cabin Crew – UK) – Strongly disagree; no experience with in-flight fire

"During training the smoke conditions that we experienced were unrealistic. We were able to see from the front of the cabin to the back." (Cabin Crew – UK) – Strongly disagree; no experience with in-flight fire

Some of the comments from the online survey indicated that current smoke training practice needed to be improved to actually provide crew with the skills or experience in using PBE in a smoke-filled environment:

"...the current practice of trying to locate a collection of hidden bags in a smoke filled cabin is in my opinion totally unrealistic and borders on being ridiculous. We should be practising real procedures in as realistic a situation as possible..." (Flight Crew – UK) – Strongly disagree; have been involved in fighting in-flight fire

"How realistic is it to pull on a mangled old [PBE make] smokehood that is already out of its box, while standing in the open air, to walk through a room bigger than my flat with a couple of rows of old seats and disco smoke!" (Cabin Crew – UK) – Strongly disagree; no experience with in-flight fire

"It would be much more realistic to be on a mock-up of an aircraft that we work on, so we can experience what it would be like to be totally in the dark and thick smoke so we can try and locate our equipment. I personally think that it would be very hard to locate the equipment in the dark and with thick smoke even with our knowledge of equipment locations." (Cabin Crew – UK) – Agree; no experience with in-flight fire

A few suggestions worth noting on this subject were on how important it was to address the differences between "training smoke" and "actual smoke" during the training. There should be an emphasis on the importance of the proper use of PBE and the characteristics and effects of real smoke.

"As the smoke isn't harmful many crew don't realise the need to use a smokehood. The smokehoods used allow crew to breath in outside air and don't give a sufficient realisation of using a real smokehood. On many occasions the seals on the hoods are loose and unrepresentative." (Instructor – UK)

"Smoke in a real situation will be corrosive and toxic. The equipment provided will only provide good protection if properly used. Because it is difficult to provide a realistic simulation of smoke conditions, which will cause discomfort, the importance of correct use of the equipment may not be realised." (Retired Flight Crew – UK)

"Whilst obviously health and safety prevents the use of toxic smoke during training, there should be a stronger emphasis on the toxicity of smoke and how quickly it can overcome an individual." (Cabin Crew – UK)

3.5.3 Similarity of equipment used in training with the equipment on board aircraft

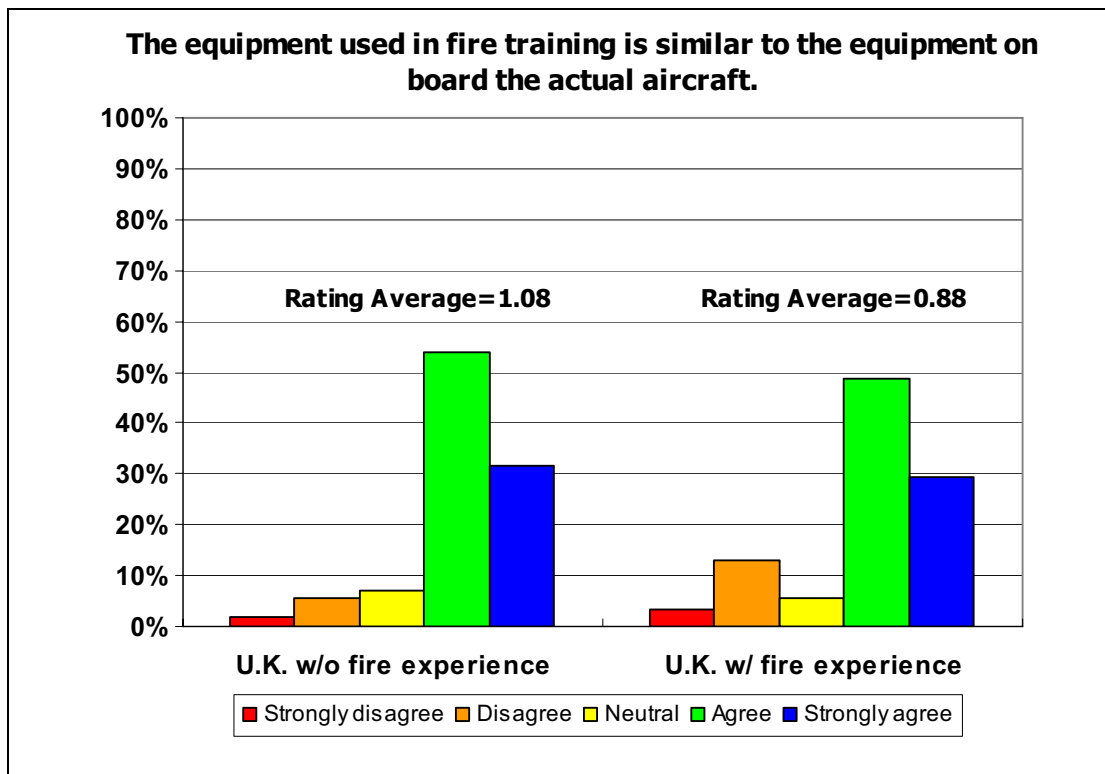


Figure 14 UK Respondents' Attitude towards the Similarity of Equipment Used in Training with the Equipment On board Aircraft

Overall, UK respondents with and without in-flight fire experience showed a positive attitude towards the similarity of equipment used in training with the equipment used on board the aircraft. Respondents with in-flight fire experience showed a less positive attitude and the difference between the two groups was statistically significant. This could be an indication that respondents without in-flight fire experience might not be completely aware of the less obvious differences or differences that could only be identified after experiencing the use of actual equipment (such as fire extinguisher integral seals).

Protective Breathing Equipment

Many comments were made on PBE training units and PBE training procedures, as follows:

"In an ideal world I would like to be able to put out a real fire using real, working equipment. Because the smokehood is just a dummy model, it is very difficult to breathe whilst wearing it as I find myself having to suck the air in from outside." (Cabin Crew – UK)

"The equipment used in fire training which I do not think is similar to the equipment on board is the PBE. In training we do not take it out of its plastic box and protective wrapping. They are also very 'battered', neck seal loose or missing. I would like to experience a really live PBE, so I would feel more confident should the need arise on board..." (Cabin Crew – UK)

"I realise there are economic constraints but I feel that all crew should experience a working smokehood at least once in training. "Dummy" smokehoods feel like it is harder to breathe, I'm pretty sure this is not the case with the real thing!" (Cabin Crew – UK)

15% of the problems encountered when dealing with in-flight fire/smoke reported in the survey by UK respondents were related to using Protective Breathing Equipment (see Section 3.7). Approximately 58% of the reported PBE problems were related to removing it from its packaging. The survey found that many respondents were concerned that they only practiced donning the PBE, not the entire process involved with its use.

"if possible make us fight a real fire under controlled conditions with proper equipment so we can experience it at least once - make us open a smokehood box and take it out and put it on at least once during our career so we can see how difficult it is to use onboard." (Cabin Crew – UK)

"...We are not used to removing the smokehood from its package, only donning training models." (Cabin Crew – UK)

"The physical opening and operation of the smokehoods in my airline could be improved, as they are already set up in the training centre." (Cabin Crew – UK)

Fire Extinguisher

As discussed in Section 3.7, problems in operating fire extinguishers accounted for 16% of the problems encountered when dealing with in-flight fire reported by UK respondents. Approximately 55% of these problems were related to the difficulty in breaking the fire extinguisher seal. Some respondents indicated the need to address this aspect in practical training:

"It would be beneficial to get the feel for an unused BCF as there have been cases of crew not able to break the seal, the one used in training is not anything like operating a BCF with seal intact, that way we will know what to expect." (Cabin Crew – UK)

"Use of a BCF is described as being substantially more difficult to break the seal before use than in training. It would be useful to experience the amount of pressure required to do this in an actual fire situation." (Cabin Crew – UK)

"Never get to test a BCF in real conditions - on a flight several BCFs were thought inoperable due to crew not being able to break the seal on the BCF, therefore wasting valuable seconds and risking a potential disaster." (Cabin Crew – UK)

"In my view, cabin crew underestimate how difficult/hard it is to break the copper wire inside a BCF which releases the red disc. The realisation and experience only comes through in practical. The manual can not prepare a crew for that eventuality." (Cabin Crew – UK)

Some others stated that the training fire extinguishers and extinguishing agent used during their training did not sufficiently represent the operating and extinguishing mechanism of actual extinguishers (in this case BCF extinguishers):

"...training equipment is easier to use e.g. BCF trigger easy to pull in training but we're told in real incident it's much harder. Same applies to smokehood." (Cabin Crew – UK)

"Having used BCF in training in the past, I find it quite different to using water for training these days." (Instructor – UK)

"Crew have commented on their difficulties when using a BCF - they are unaware of the strength needed to break the seals and the power and range when dispersed and a "test squirt" sometimes jams the trigger mechanism open - most crew were unaware of the procedure to un-jam (pull back out) the trigger." (Cabin Crew – UK)

A comment highlighted the concern with the different types of fire extinguishers requiring different operation and handling installed on the airline's fleet:

"... It is also confusing in regard of handling the BCF because the airline that I work for has at least two different types that require different operation and handling..." (Cabin Crew – UK)

Some respondents considered that using a water-charged training extinguisher could not sufficiently replicate the use of an actual Halon fire extinguisher and suggested showing a video demonstrating the use of an actual Halon extinguisher and its effects:

"I appreciate that we cannot use BCF, but it would be good to see a video showing just how effective it is." (Cabin Crew – UK)

"I think real scenarios should be used and real BCF used to put out a fire so that crew know what to expect in reality e.g. that a paper fire can result in burning embers being scattered and how quickly a fire in a confined space can be extinguished by a relatively small amount of BCF. I realize that there are environmental concerns with the use of BCF for demonstration purposes though. Film demo may be a way around this." (Cabin Crew – UK)

3.5.4 Adequacy of fire training facility

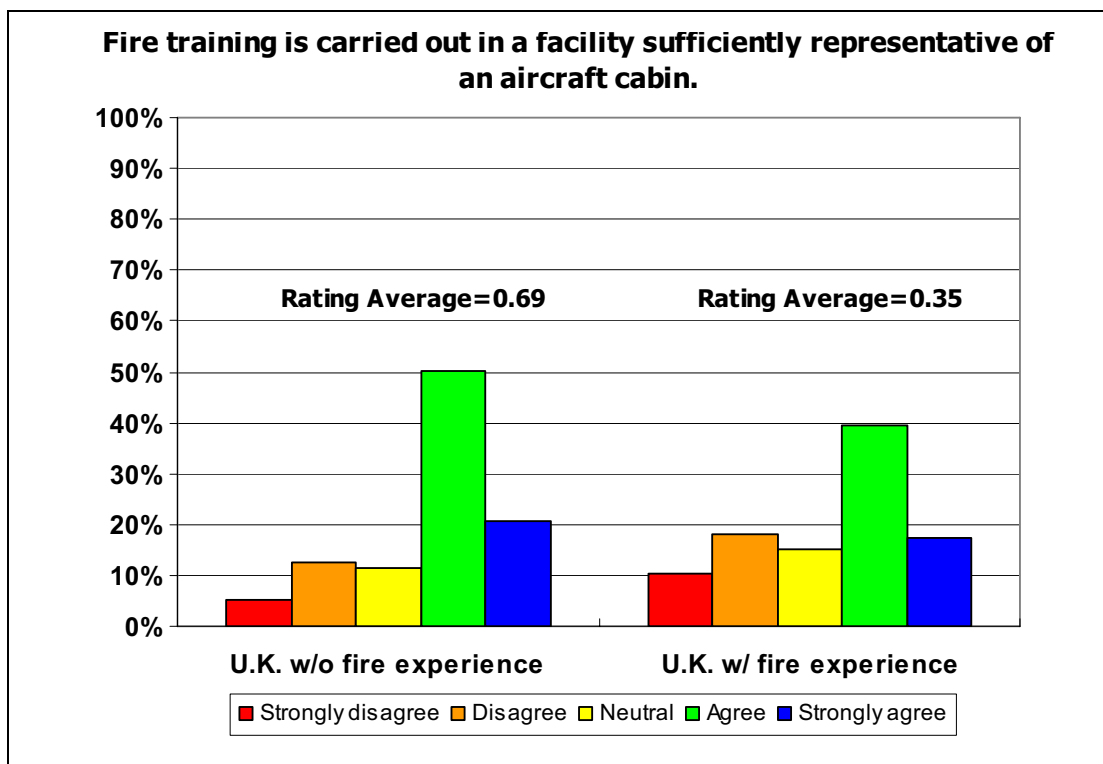


Figure 15 UK Respondents' Attitude on How Representative the Training Facility is of an Actual Aircraft Cabin

Overall, UK respondents were positive about how representative their fire training facilities were of an aircraft cabin. Again, UK respondents without in-flight fire experience were more positive than UK respondents with in-flight fire experience.

The comments received on this subject indicated that, whilst smoke training facilities were fairly representative of an aircraft cabin, fire training facilities were usually not.

"Always done fire training outside in the cold on metal mock-ups which aren't always obvious as to what parts of aircraft they represent" (Cabin Crew – UK)

"We do fire drills in a covered space outside with plenty of access and light and none of the difficulties of an in - cabin situation...." (Flight Crew – UK)

"The oven fire fighting we do is not carried out in a mock-galley. It would be good to use a mock galley to practise in an area of limited space instead of just outside under a tin roof." (Cabin Crew – UK)

Some of the comments indicated that there was a high variability in the standard of training facilities:

"So much depends on the operators level of practical equipment, I have experienced excellent, well funded facilities, but also many that are poor and certainly not compliant with JAR/CAA requirements." (Instructor – UK)

"There is too much variation in the location at which the fire training is carried out! Some places are excellent with realistic a/c mock-ups, whilst others are like a shipping container - which although practical in its sturdy construction; bears absolutely no resemblance to an a/c! I have also found that given the time constraints on such mock-ups; there is usually a rushed approach to get everyone in the chamber to 'spray an extinguisher' and get out!" (Cabin Crew – UK)

Based on the comments, it appeared that some respondents felt that there was an advantage in carrying out their practical fire training in a cabin mock-up, rather than in a basic, open-air facility.

"The simulator sessions when we fought "fires" in the cabin were much more effective and allowed us to react the way we probably would in-flight however the outdoor training where we discharged a laser BCF at real flames was useless as it was expected and involved no realistic teamwork to fight the fire." (Cabin Crew – UK)

"... Working in a proper simulated environment that mimics an actual aircraft (with the need to remove panels with crash axe, toilets, overhead lockers etc) would be much better than an outdoor metal box with gas burners that in no way resembles an aircraft or its confined environment and materials." (Cabin Crew – UK)

Comments made on this subject indicated that many respondents would like to use a cabin mock-up more representative of their aircraft type for training in locating firefighting equipment. However, this might be problematic because most cabin mock-ups were generically designed to cater for crews operating as many aircraft types as possible.

"...also it should be more representative of aircraft type, when we get to the fire the equipment is on a seat to use... it would be better to have equipment in different areas." (Cabin Crew – UK)

"The instructors also shove some BCF's on the last row of seats, which is ridiculous as that's not where they are located onboard our a/c. They should be in the appropriate stowage so I can see how easy/hard it will be to find it in a smoke filled environment." (Instructor/Senior Cabin Crew – UK)

"The simulator that we use in training is nowhere near like any aircraft that we fly on, i.e. the layout yes but the equipment should be placed exactly where it is as if it's a real scenario, therefore crew would appreciate removing equipment from stowages and tackling fires..." (Cabin Crew – UK)

"The smoke filled cabin was freakishly realistic however the sim in which we practice the emergency scenarios is half [an aircraft type] and half [another aircraft type] (forward being [an aircraft type] and aft being [another aircraft type]) which meant that equipment locations did not exactly match that of the actual a/c one was going to be operating on." (Cabin Crew – UK)

"To make the scenario more realistic, there should be a primary scenario concerning the practicalities of fighting a fire, then a secondary scenario with 'passengers' and equipment placed in its correct location so crew would have to find it, (open the smokehood etc) and make it more relevant to a cabin environment. My previous airline [...] did this and although it felt pressurised, it was interesting to see how different crew reacted." (Cabin Crew – UK)

3.5.5 Relevancy of training scenarios to aircraft operation

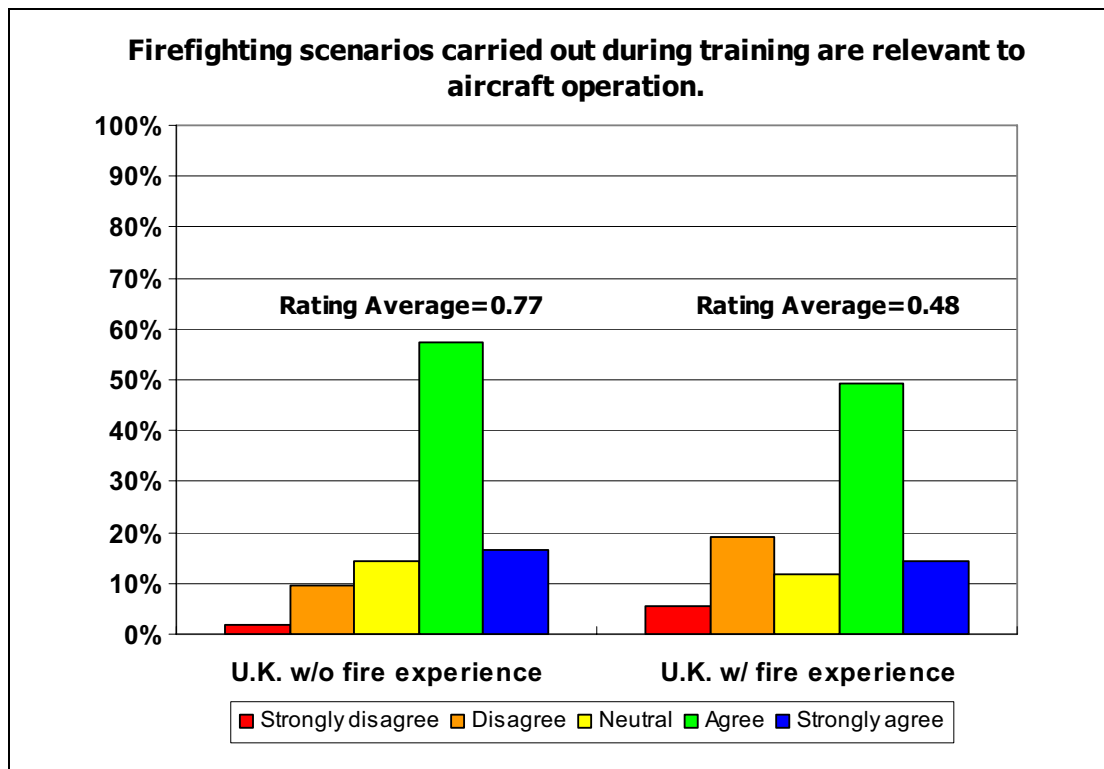


Figure 16 UK Respondents' Attitude towards the Relevancy of Training Scenarios to Aircraft Operation

Overall, UK respondents were quite positive about the relevancy of fire training scenarios to their aircraft operation. UK respondents without in-flight fire experience were again more positive than UK respondents with in-flight fire experience.

Based on the comments received, there were indications that 'third-party' training providers may be more likely to provide fire training scenarios that were not relevant to the operator's operation, as mentioned in the following comment:

"Scenarios carried out by training companies as opposed to airlines' own training department do not relate to the specific airline - I used to work for a low cost company and IFE fire was covered, low cost airlines do not have this." (Cabin Crew – UK)

This issue is discussed further in Section 3.6.1.

Integrated fire training scenario

In Section 3.7, it was revealed that problems in locating/accessing source of fire accounted for 19% of the problems encountered when dealing with in-flight fire/smoke reported in the survey by UK respondents. Nevertheless, some respondents indicated that their practical fire training did not involve training in locating the fire source.

"...at the moment, we all line up and extinguish a fire in an oven - not very realistic at all. Setting it up so we don't know where the fire is going to be or what type it is, who is going to be the first to tackle it etc would make it more realistic." (Cabin Crew – UK)

"... The mock-ups aren't overly realistic with only 1 overhead locker and 1 toilet in the mock-up. It's too predictable" (Instructor – UK)

"A lack of practical training outside the basic CAA/JAR OPS requirements. Crew should be provided with opportunity to face various "surprise" scenarios on a/c mock-up or simulator." (Cabin Crew – UK)

Problems in accessing/removing firefighting equipment from the stowage account for 9% of the problems encountered when dealing with in-flight fire/smoke reported in the survey by UK respondents. Some respondents indicated that practical training in removing firefighting equipment from the actual stowage would be beneficial:

"...more practical work with actual stowage on a/c would be beneficial." (Cabin Crew – UK)

"I have always stated that it would be useful to retrain people on how to actually release the equipment from stowages, as we only view the all of our safety equipment on each security/safety check. Removing it is a totally different matter and each piece of equipment has a different means by which it is stowed. As we don't EVER practice removing equipment from stowages - it could be a time hindrance if there was a need to do it in a hurry and possibly in a smoke filled cabin..." (Cabin Crew – UK)

Approximately 44% of the problems in operating fire extinguishers when dealing with an in-flight fire reported by UK respondents were related to discharging the fire extinguisher. Some of these were due to the difficulty in discharging the fire extinguisher while wearing fire gloves (see comments in Section 3.7). It was suggested by some respondents that the protective equipment that they would be wearing on board should be used during the practical fire training:

"We do not practice fighting (simulated) fires while wearing the appropriate safety equipment - smoke hood & gloves - so the first time these are worn while trying to let off an extinguisher is the day it happens for real." (Flight Crew – UK)

"Smokehoods should be worn while discharging an extinguisher with BCF characteristics into spaces that represent panels and toilet bins, allowing crew to familiarise themselves with the limitations to vision and communication that such a scenario entails. Merely squirting water into an oven-shaped box without any protective equipment on is not adequate training." (Flight Crew – UK)

Some comments indicated that smoke simulation should be present during practical training:

"Firefighting scenarios are carried out in the training facilities of the airport fire brigade. This means it's an open container with a toilet, overhead bins, seat and oven. During training there is no actual smoke. However we train in the cabin trainer to simulate smoke conditions. But this training is restricted to find a

person in a smoke filled cabin. Fighting a fire in a cabin when the cabin is filled with smoke is never simulated.” (Flight Crew – UK)

“The training in our airline is separated as the smoke filled cabin does not occur in the same location as the fire fighting drill practical location so when you are fighting a fire in practical there is no smoke or realistic cabin to simulate a scenario effectively.” (Cabin Crew – UK)

Based on these comments, an integrated fire training scenario, where all aspects of an in-flight fire are realistically present and cabin crew are required to carry out all elements of fire training, appears to be the ideal scenario. By implementing an integrated scenario, the training would not only include the firefighting technique and procedures, but would also incorporate locating and accessing the fire, locating and removing firefighting equipment, and wearing protective equipment during the entire process.

3.6 Procedures in Training

3.6.1 Relationship between procedures in training and in crew operating manuals

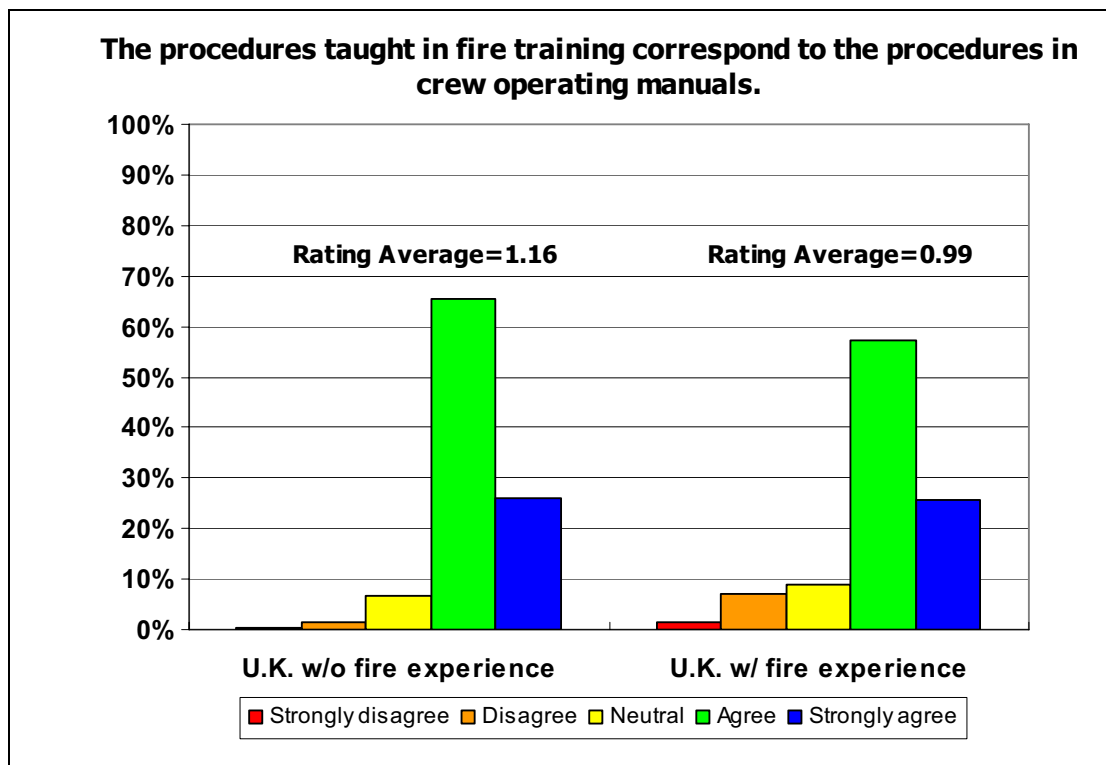


Figure 17 UK Respondents' Attitude on How the Procedures Taught in Fire Training Correspond to the Procedures in Crew Operating Manuals

The responses indicated that most of the UK respondents, from both with and without in-flight fire experience groups, were positive about how the procedures taught in fire training corresponded to the procedures in the crew operating manual. However, the comments received by respondents who received/provided training from a 'third-party' training organisation indicated that there was a need to ensure that procedures taught in training conformed to the company's operating procedures.

“As RFFS, we are never sure what individual company procedures are in the event of a fire/smoke situation. We advise candidates on how to deal with incidents but always summarise with follow your company SOP's.” (Instructor – UK)

"At times using a 'third-party' training provider fire fighting procedures can sometimes inadvertently contradict what the company procedures state. This being because fire officers are enlisted to train our practicals and we do not have one of our instructors present. Therefore, you can get the fire officers view point, which at times can be useful, but it should be consistent with the company procedure so as not to cause any confusion." (Cabin Crew – UK)

"Our practical training is done by a 'third-party' company who are not familiar with our manual." (Instructor – UK)

"Taught by another airline so they are not aware of our drills or practises." (Cabin Crew – UK)

"Fire crew conducting training do not have sufficient knowledge of specific airline procedures." (Cabin Crew – UK)

"Perhaps more consistency between operators and training providers as to the quality of training facilities... Non AOC training-provider Instructors need a greater understanding of JAR OPS, CAP 768, Crew resource Management, and crews evacuation techniques to be able to understand the larger role of crew in relation to in-flight fire/smoke emergencies. Carry out more practical fire/CRM joint exercises across the industry." (Instructor – UK)

The comments received on the subject of firefighting procedures again indicated that cabin crew appeared to regard the 3-crew procedure as a "hard and fast" procedure, as previously highlighted in Section 3.4.2 (Training for simultaneous, multiple fires).

"I am concerned that the training is too prescribed and procedural, making crew feel scared to act unless they are in the correct role. 'No I can't help you fight the fire because I'm the communicator'!!!" (Cabin Crew – UK)

"The cabin crew procedures are very prescriptive and rely on defined roles in the event of a fire. Cabin crew are never encouraged in training to use their own judgement or indeed common sense. In simulation scenarios they are so wrapped up in following the 'rules' that it takes a long time to actually tackle any fire! We operate with minimum crew (3 on [aircraft Type]) which doesn't fit too well with their procedures..." (Flight Crew – UK)

"... I think too much emphasis is placed on the procedure ie labelling the three people involved and defining their roles although I understand the importance of ensuring particular jobs are carried out, such as informing the captain, moving oxygen, etc." (Cabin Crew – UK)

3.6.2 Procedures for communication and coordination between flight crew and cabin crew

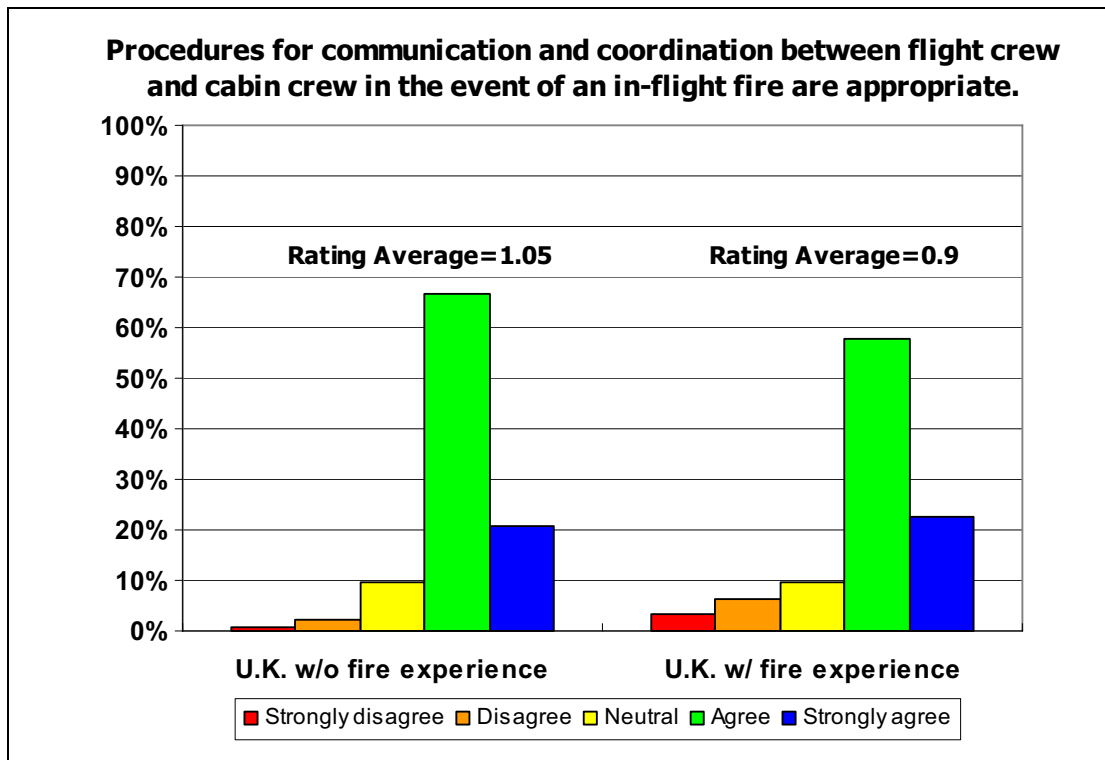


Figure 18 UK Respondents' Attitude on the Appropriateness of Procedures for Communication and Coordination between Flight Crew and Cabin Crew during an In-flight Fire

The responses indicated that most of the UK respondents, from both with and without in-flight fire experience groups, were fairly positive about the appropriateness of procedures for communication and coordination between flight crew and cabin crew.

However, some comments received indicated that practical training on this subject was insufficient. Although a few respondents stated that their training had involved practice with flight crew on communication procedures, the majority of the comments indicated that there was a need for cabin crew and flight crew to carry out joint training involving communication and coordination procedures.

"There needs to be comprehensive training in the interaction between Flight Deck and Cabin Crew for serious fire/smoke/fumes scenarios." (Flight Crew – UK)

"Would be good to practice with flight crew. Have spoken to one captain who said he would send the first officer to get involved/pass on information as he has no faith in us crew." (Cabin Crew – UK)

The lack of joint training between cabin crew and flight crew was probably one of the reasons why some cabin crew did not seem to be very aware of the required flight crew actions in the event of in-flight fire and vice versa, as indicated in the following comments:

"Flight crew's knowledge of the cabin crew roles in a fire fighting drill are very poor. From my experience they do not appreciate the workloads of the cabin crew during this and are often overly critical of the cabin crew. There is no way

near enough joint training so both cabin and flight crew can see each others roles/responsibilities.” (Flight Crew – UK)

“The procedures for the communicator tend to make them think a “running commentary” is required. In the real event the flight crew would need information, but would also need a lot more time to communicate with each other and ATC. They would also need some thinking time and a meaningless string of words over the interphone (which is very loud) would not help at all. They should be briefed to tell us of changes and be on the line to answer questions, but not turn into a DJ.” (Flight Crew – UK)

“I think there is a lot of disparity between flight crew and cabin crew training. I.e. in a briefing recently the captain joined us and after all our questions which were in relation to a behind the panel fire he said he would be waiting for us to tell him the fire is out. We replied by saying that in that instance we would never presume a fire is completely out. We would simply communicate that what we see...if smoke has stopped coming out from behind panel that is what we would tell him. Whilst we do practise in the mock cabin communicating the captain, it is the trainer that takes role of captain. It would be good to have a real captain join us to know what we [have] to do and say.” (Cabin Crew – UK)

Some comments suggested that firefighting training should be carried out with flight crew and cabin crew wearing Protective Breathing Equipment.

“Would also like to know how difficult it is to communicate on the interphone wearing a smokehood...” (Cabin Crew – UK)

“Cabin Crew need to hear a pilot talking to them with a cockpit oxygen/goggles on. Both face to face and via intercom/PA.” (Flight Crew – UK)

Some respondents were concerned about the lack of procedures for communication in the event of an inoperative interphone system, in relation to the locked flight deck door policy:

“The locked door to the flight deck has of course reduced the quality of communication and now we are more dependent on the interphone.” (Flight Crew – UK)

“While in theory the procedures for communication may seem appropriate, in the event of a real fire if the PA/interphone system were to fail there is no real way of communicating with the flight deck.” (Cabin Crew – UK)

“... we've never practiced communicating on an actual functioning interphone wearing a smokehood. Also, no procedure in place for communicating with cabin crew to flight crew if interphone is not working.” (Cabin Crew – UK)

Problems in communication/coordination between cabin crew and flight crew accounted for 10% of the problems encountered when dealing with an in-flight fire/smoke occurrence, as reported in the survey by UK respondents (see Section 3.7 Problems Encountered During Firefighting).

3.6.3 Procedures for communication and coordination between cabin crew

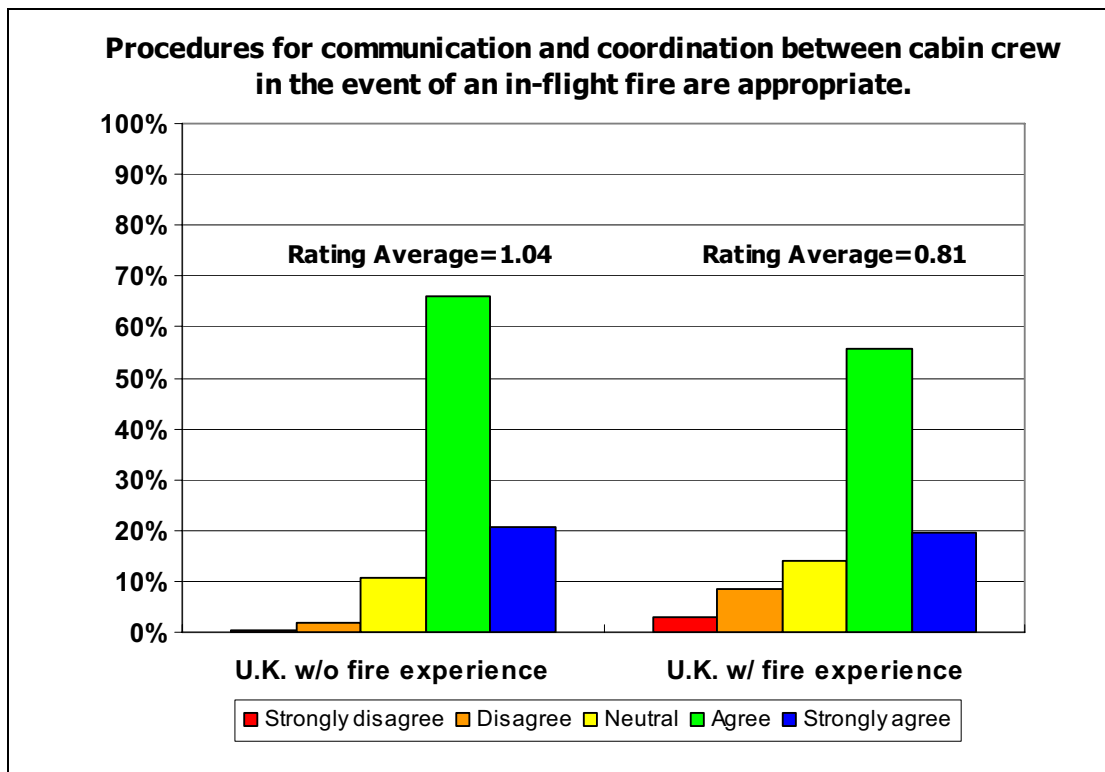


Figure 19 UK Respondents' Attitude on the Appropriateness of Procedures for Communication and Coordination between Cabin Crew during an In-flight Fire

The responses indicated that most of the UK respondents, from both with and without in-flight fire experience groups, were fairly positive about the appropriateness of procedures for communication and coordination between cabin crew.

However, some comments indicated that some operators/training organisations did not particularly allocate enough time on communication between cabin crew during practical training.

"The procedures are there however the applied CRM skills are not tested fully in modern realistic aircraft mock-ups. The theory is there but the practical should be given more time to put the theory into practice." (Cabin Crew – UK)

"Maybe would be useful to have a practical training session on this aspect [communication/coordination] of fire fighting. The practical tends to concentrate on just the fire fighting element." (Cabin Crew – UK)

The use of PBE whilst practicing communication during training was again highlighted by several comments:

"I think in training we should all try and communicate with a smokehood on, have you ever tried it? it's very difficult to hear and talk, and it's even worse when there's a fire behind you. I tried this in [...] training but not in my current employers training, I think this should be mandatory as it makes you realise how difficult a simple thing can be." (Cabin Crew – UK)

"With everyone on breathing equipment communication will be very difficult if not impossible and this is hardly covered in training." (Instructor – UK)

"I think the difficulties of communicating between each other while all cabin crew are wearing smokehoods is underestimated." (Cabin Crew)

A few suggestions worth noting on the subject of communications were as follows:

“When communicating, it would be useful for all stations interphone so at least someone in the opposite end of the cabin on a large aircraft to listen in on what is being told to the flight crew, and this could be passed to crew in the forward part... especially if a divert is possible as they can start to secure etc..” (Cabin Crew – UK)

“I think the communicator should get all information to be related to the flight crew, from his/her own, first-hand, observations and from speaking to the fire fighter directly. The information passed to the flight crew will then be accurate. I find that, during training scenarios, the information, being passed from crew to crew becomes a bit like Chinese Whispers and the information gets altered along the way. I really noticed this during my recent SEP refresher...” (Cabin Crew – UK)

Problems in communication/coordination between cabin crew accounted for 24% of the problems encountered when dealing with in-flight fire/smoke reported in the survey by UK respondents (see Section 3.7 Problems Encountered During Firefighting).

3.7 Problems Encountered During Firefighting

Overall, 123 respondents reported a total of 262 problems. From the UK only, 81 respondents reported a total of 165 problems. Of these, 52 had been involved in fighting an in-flight fire and 29 had witnessed an in-flight fire.

According to Figure 2 there were a total of 99 of UK respondents who had been involved in fighting an in-flight fire. This means over 52% of them had at least one problem in the process.

The categories of firefighting problems presented in the following charts are slightly different from those in the survey form, as some problems are grouped (see Table 6).

Figure 20 shows the proportion of each problem category experienced/witnessed by UK respondents.

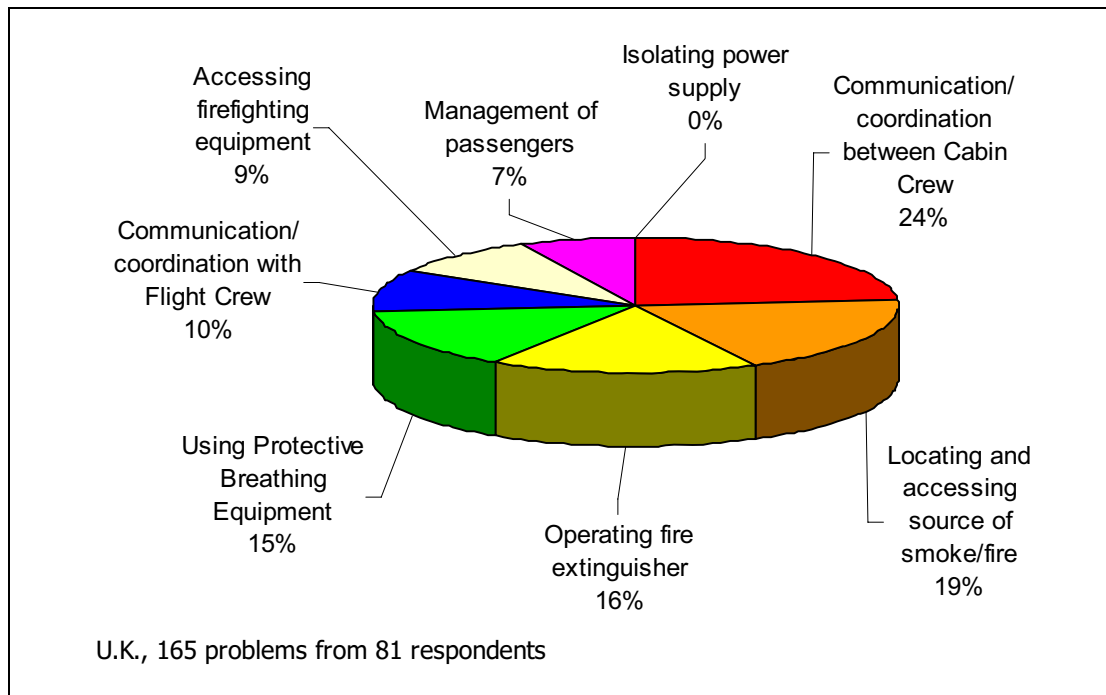


Figure 20 Problems Encountered during In-flight Firefighting Reported by UK Respondents

The following are detailed comments on some of the problems experienced by UK respondents.

Accessing firefighting equipment

"Some of our equipment is stowed in ridiculous places and access can and will be difficult in a serious onboard fire."

"Many different locations of BCF fire extinguishers and these vary from fleet to fleet and aircraft type to aircraft type..."

"Very difficult to remove Halon extinguisher from 'doghouse' stowage"

Communication/coordination between cabin crew

"Lack of information. There was an acrid smell in the cabin. When I reached the forward galley and found my colleagues missing, I had to put 2 and 2 together. I didn't open the cockpit door as per training but realising we were in trouble, I began preparations by stowing all galley equipment."

"Crew failed to advise crew at rear of a/c of incident, only time we realised something was wrong was when captain announced diversion."

"Panic in the team caused communication problems. Not knowing who to inform SCCM or flight crew"

"The lesson was that when under normal crew complement, the communications procedures were impaired. Every single cabin crew member had a different approach to the "fire". From the completely relaxed to the absolute panicked."

Communication/coordination between cabin crew and flight crew

"...One cabin crew member dealt with [the fire] and communicated with flight deck contrary to company operating procedures, as the other cabin crew were too involved with a drinks service I think. This made the situation more difficult to manage from the flight deck as I had to tell an "experienced crew" what to do and those at the front were unaware of the incident until being told by me. All the crew were thoroughly debriefed"

"Use of oxygen under pressure makes it very hard for cabin crew to understand what Flight deck are saying. Had to turn off continuous pressure, hold breath, and speak slowly. In the end it was easier to give one-way messages over PA."

"In the event SOP communication methods [the Communicator/Co-coordinator/Fire Fighter method] broke down - all we as flight crew received was the cockpit door suddenly opening and the Senior shouting "there's a fire in the cabin" then disappearing. However shortly after she returned to give a full report, including that the fire was out."

"I was once the "communicator" in a small electrical fire on board. When I called to inform the captain of the incident I was under the impression (according to my S.E.P. manual) that we were to maintain constant communication throughout the incident but instead I was told by the captain to call back "...when something changes"! I believe that the flight crew once notified of an incident such as a fire are extremely busy and maintaining constant communication might be unrealistic therefore I believe that we should follow a different procedure."

Locating and accessing source of smoke/fire

"I knew it was coming from behind the cradle form-work, but could not immediately work out how to dismantle this to check that the fire had been extinguished by the BCF shot, from the cabin staff involved. I did not use the axe/jemmy, as I knew that there were a multitude of wires behind there."

"Finding the source of the fire was not easy as it was behind a panel. We had to 'feel' the panels on the aircraft and behind the hot one was the fire."

"Smoke from inside First Class seat. Procedures were revised to detail how seat panels could be removed to allow access to all parts of seat including the electronics and motors."

Management of passengers

"...More time needed for other crew not directly involved in fire fighting in being taught how to manage the pax."

"Passengers panicked and I had no idea how to calm situation - they were all standing up shouting..."

"Cabin crew not capable of demonstrating crowd control on worried passengers."

Operating fire extinguishers

"... Although steps have been taken to enforce the power needed to break the seal of a BCF it's still a long way short of reality..."

"Was not using the equipment personally but crew member struggled to break seal on the BCF..."

"...On both occasions extinguisher failed to operate due to the seal inside being difficult to break crew thought extinguisher was broken..."

"When you have the fire gloves on it is difficult to operate the extinguisher. The equipment is very tightly packed that it takes time to open and use."

"Breaking seal on BCF was impossible wearing fire gloves"

"The green BCF was used in conjunction with the fire gloves. It was made difficult to place fingers in to the wells provided as this is not the biggest area when wearing the fire gloves."

Isolating power supply

The survey did not ask specifically for problems in isolating the power supply during firefighting. There was no mention of this problem in the comments submitted by respondents.

Using Protective Breathing Equipment

"Very difficult to communicate effectively with anyone when wearing the [PBE make] smokehood. All parties found this a definite obstacle..."

"Insufficient training and practice given to removing PBE from stowage removing PBE from its packaging..."

"The smokehood took a long time to unfold from the packaging and was very stiff."

"Accessing smoke hoods is difficult then once it is on it is difficult to communicate verbally. As it sounds very muffled..."

"...and smokehoods were never donned, staff are afraid of the cost of inadvertently opening hoods and using them + paperwork it creates."

3.8 **Relationship Between In-flight Fire Experience and Perception of Adequacy of Training**

Some of the statements in the survey investigated how the respondents perceived the adequacy of various aspects of cabin crew fire training. When asked about the adequacy of the training and its associated elements, and the adequacy of the relevant procedures, it is likely that the responses would reflect how confident they were in their knowledge, skills, and the existing procedures in dealing with in-flight fire.

Statistical tests of significance were carried out for some of the statements to investigate whether there was a significant difference in the responses submitted by those who had in-flight fire experience and those who had no in-flight fire experience.

The tests of significance showed that statistically significant differences existed between respondents with in-flight fire experience and respondents without in-flight fire experience in the following subjects:

- Adequacy of training for multiple, simultaneous fires
- Adequacy of training for fires visible in the cabin
- Adequacy of the training for the management of passengers
- Similarity of equipment used in training to the equipment on-board the actual aircraft
- Realism of fire conditions
- Realism of smoke conditions
- Adequacy of fire training facilities
- Relevancy of firefighting scenarios in training to aircraft operation
- Consistency between procedures taught in fire training to the procedures in operating manuals
- Appropriateness of procedures for communication between flight crew and cabin crew
- Appropriateness of procedures for communication between cabin crew

In all of the above subjects, respondents without in-flight fire experience exhibited a more positive attitude than respondents with in-flight fire experience. This could be an indication that some degree of false confidence might exist in respondents without in-flight fire experience. This could be due to the fact that the possible difficulties that might be encountered during an actual in-flight fire could not be experienced or were not replicated during fire training.

Crew members themselves recognised the potential for cabin crew to have false confidence, as reflected in the following comments:

"If no real fire training can be given, it is better not to give fire training at all. It gives crew a false confidence they can handle fires, which makes it even more dangerous. ...It is obvious to anyone that a yearly 45 minute safety course followed, by 25 minutes of CRM and only 15 minute every two years for fire drill is not adequate to have a good safety standard..." (Flight Crew – UK)

"...Other training courses I have been on were very bad due to "health and safety". Try putting out a fire in an oven that only goes out when the instructor turns off the gas supply to simulate putting out a fire..... It really did not work and it could easily misguide people who do not know any better." (Flight Crew – UK)

Some UK respondents without in-flight fire experience stated that they found it difficult to assess the adequacy of their training and/or facilities, as they had no knowledge of the actual conditions of an in-flight fire event.

"Having never been in real aircraft fire situation, I wouldn't know if scenarios are realistic, but I would imagine they wouldn't be as fire spreads so quickly in real life." (Cabin Crew – UK) – Neutral

"Cannot honestly answer the two neutrals [realism of fire and smoke] as I have never witnessed an on board fire." (Cabin Crew – UK) – Neutral

Not knowing whether the fire/smoke conditions and scenarios during training were realistic could be an indication that some cabin crew might not receive adequate information on actual in-flight fire/smoke occurrences during their training. It could also indicate that the differences between training and actual aspects of in-flight fires were perhaps not (sufficiently) addressed. Many respondents suggested the use of videos for this purpose:

"Would like to have more discussion about real events and possibly see videos of true events..." (Cabin Crew – UK)

"Having experienced real smoke training (wearing firefighter's BA), I can see that the "Disco" stuff is very different. In particular the 9 inches clear gap above the floor does not happen and this bit can be vital. You only understand it when you see it. Even a video would be good." (Flight Crew – UK)

"Possible video evidence of actual cabin fires, using staged material or documented material." (Cabin Crew – UK)

"How about DVD documentaries with background information of real incidents? It would be interesting to see how a fire situation in midair occurs and develops. Investigating crew reaction and fire fighting techniques." (Cabin Crew – UK)

3.9 Evaluation Criteria

Based on the comments received from UK respondents, there was an indication that some instructors had a lenient approach in dealing with inadequate proficiency demonstrated by trainees during practical training:

"Cabin crew often fail to carry out the proper procedures and fail to extinguish the fire BUT they are still released to the line." (Flight Crew – UK)

"Many more students should have failed their fire and smoke than actually did, pressure from the airlines management staff due to cost of training were placed upon trainers to pass students which border line." (Instructor – UK)

"Time is sufficient, however during practical training anyone with asthma or any other medical condition doesn't have to carry out the exercise where we are required to enter smoke filled cabin wearing smokehood. What exactly are they going to do in a real emergency!?" (Cabin Crew – UK)

"People that are "scared/claustrophobic" appear to get almost let off/treated with kid gloves When in reality it should be marked as a fail ... this is mainly in the area of wearing a smokehood" (Cabin Crew – UK)

"Pilots rarely have any training, and from what I have seen of the cabin crew I honestly believe only about 10% could extinguish a fire. Most are incapable of passing SEP but the company pushes them through irrespective of their inabilities." (Flight Crew – UK)

"Insufficient practical training. There are often cabin crew in tears at practical training sessions because they cannot deal with putting a smokehood on, before they even start dealing with an actual fire. Instructors unfortunately pander to them and give them unrealistic assistance to get through the exercise which defeats the object. If you start hyperventilating at the sight of a smokehood in training then you're just going to be inhaling more smoke in a real life situation and be no use to colleagues/passenger. Every time I do recurrent fire training there is at least one person in a group of 15-20 that has issues with the smokehood.....the bottom line is that they should not be flying!" (Cabin Crew – UK)

Some UK respondents expressed their concern about the lack of standards for ensuring trainees' proficiency during practical training, such as a pass/fail examination, as suggested in the following comments:

"The fire training plan used by my airline aims to train the cabin crew and flight crew in fighting fires in the cabin. However, when crew do not carry out the drill successfully, there is no PASS/FAIL element emphasised by the trainers. So usually a facilitative debrief is carried out and no re-test taken. This gives the impression to crew that getting it wrong is ok." (Flight Crew – UK)

"There needs to be a more competence based approach to training so that knowledge and understanding can be confirmed." (Instructor – UK)

"New Entrant Cabin Crew in particular do not get sufficient time to become confident and competence in their drills. All New Entrants are not assessed on each part of the fire drill." (Instructor – UK)

"Everyone should have to do proper fire drills with scenarios and exams in the same we do the various evacuation drills." (Cabin Crew – UK)

"I think there should be a practical TEST every year for crew to don smokehood and gloves and in a smoke filled environment, find, fight and extinguish - different types of fire." (Flight Crew – UK)

"Company has very good facilities, the training program is adequate, but it is let down in its execution by the lack of realistic feedback and assessment of the crew." (Flight Crew – UK)

The lenient approach of the instructors and the lack of a standard for demonstrating proficiency might contribute to a lack of confidence in the ability of fellow crew to deal with an in-flight fire, as indicated in the following comments:

"I am confident in fighting a fire myself. However I would have doubts with some of my other crew members." (Cabin Crew – UK)

"... My feeling is that there are some crew who I would feel confident in working with to deal with a fire situation, yet there are some who I would not want to be in that situation with. Attitudes and abilities vary and this is exacerbated by the fact that we are always working with people we don't know - due to size of operation and scheduling." (Cabin Crew – UK)

"I have observed some cabin crew who are particularly stressed when they have to wear a smokehood and enter a simulated smoke filled cabin, this does not instil confidence in the event of a real cabin fire." (Flight Crew – UK)

"Feel that fire training is often just theoretical and would question whether all crew would actually be able to deal with fire onboard should it occur." (Cabin Crew – UK)

"... Cabin crew are not given appropriate feedback, even when it is a shambles (regularly), none of the trainers want to 'own' the problem when performance is dire. Most crew claim claustrophobia, etc in a smokehood, some to the point of hysteria, not something I've personally had a problem with. Sure it's not pleasant, but then nor is the real thing and as flight crew I find it very worrying to consider what will happen if some of these crew ever get faced with the real thing!! I don't feel confident with their training. Either the training smokehoods need adapting to feel like a real one when activated, or crew should do it again and again until they are 'comfortable'. ... Either they can do it or they should have 're-training', in my opinion. Flight crew in my company do not have a lot of faith in the cabin crew SEP training, mainly due to point 2 above..." (Flight Crew – UK)

"... I am frequently presented with a crew of young, inexperienced people, and I am left hoping that something serious will not occur that day. I doubt some would have the presence of mind to deal effectively with a fire - which would be random in nature and not one of their text-book scenarios. In many cases I would imagine that assertive passengers would be relied upon to take on or assist with the fire fighting role. Worrying." (Flight Crew – UK)

3.10 **Required Urgency of Response to an In-flight Fire Event**

Several UK respondents commented on how the required urgency of response was not sufficiently stressed in both practical and theoretical training:

"... Crew need to act immediately remaining calm but fighting and controlling the fire with urgency. In my opinion this is not really emphasised enough during a 3 day recurrent." (Cabin Crew – UK)

"The issue that a cabin fire has to be discovered and dealt with ASAP is not reinforced." (Flight Crew – UK)

"Too often cabin staff are unaware of the time-critical nature of this risk. It is often talked of in a joking manner." (Flight Crew – UK)

"Not enough background information is given to enable the crew to understand why they are doing each part of the drills and the seriousness of fire onboard." (Instructor – UK)

"Overall, most people will have never experienced a real unintentional fire. On the ground, help can get to you fairly quickly, and even then, time is critical. Effective fire fighting is essential. Airborne, you are exposed to the effects and events for a long time with no backup. The seriousness of the situation can be taught, and accepted. I do not feel it is truly appreciated following most training courses." (Flight Crew – UK)

The use of accident/incident videos during the theoretical training, while highlighting the amount of time the crew actually has to deal with an in-flight fire until it becomes uncontrollable, may be a good method to emphasise this issue. A respondent suggested timing the required response of the trainees during practical training to instil the sense of urgency of an in-flight fire event:

"When in training I feel we should be given a time allocation in which to put out or deal with the fire, during training crew tend to 'dilly dally' when putting on smokehoods I feel this is down to not feeling a full effect of a 'real' fire i.e. heat." (Cabin Crew – UK)

3.11 **Single Cabin Crew Operation and Minimum Crew Complement**

The industry-wide Firefighter – Assistant Firefighter (Coordinator) – Communicator firefighting procedure would not appear to accommodate aircraft operating with less than three cabin crew. Responses suggested that a standardised procedure for an in-flight fire event on a single cabin crew operation, in particular, is greatly needed. The following comments related to this issue:

“Perhaps stronger regulatory guidance or a standard for single (or no) cabin crew operations.” (Instructor – UK)

“... the difficulties of single cabin crew operations need to be fully addressed. Possibly aircraft with more than, say, nine passengers should be certificated as requiring more than one cabin crew member.” (Flight Crew)

“Training required on fighting different types of fires, also on passenger handling during fire fighting, particularly on aircraft with single cabin crew member” (Flight Crew – UK)

“Specific to [Aircraft Type] a/c with one cabin crew. Management of pax whilst fighting the fire in a situation where crew are obliged to don breathing apparatus (no communication with pax) I feel would be un-manageable.” (Flight crew – UK)

“The difficulties in communication for operators of single cabin crew aircraft present particular problems, which are not fully addressed by standard fire fighting training.” (Flight Crew – UK)

Some crew operating on smaller aircraft types raised their concern regarding the increasing practice of minimum crew complement on their fleet:

“With minimum crew compliment it is not possible to have three crew members involved in fire fighting i.e: fighter, communicator and co-ordinator.” (Cabin Crew – UK)

“Make airlines insist that crewing levels in all galleys are sufficient that at least 3 crew are in every galley, not the usual airline operators excuse that there is 1 crew member in one galley and there are 2 in the next galley and that’s sufficient. Question is what if those 2 are out in the cabin dealing with another issue, medical emergency perhaps. Cutbacks are the airlines way but one fatal fire and they will only have themselves to blame!” (Cabin Crew – UK)

“My only concern is if we continue to reduce the minimum crew on aircrafts and Airlines give unrealistic turnaround times this puts extra pressure on everyone and then things are over looked and mistakes happen.” (Cabin Crew – UK)

“The procedures may be right but the actual situation it may not happen like that. Also with less crew now on board the ability to have 3 crew in the fire fighting scenario is not going to happen in the quickest response time. Have spent many times flying when I have been the only crew member around for great lengths of time and had there been a fire, particularly late night flying, there is no way that crew could extinguish and communicate and co-ordinate a fire procedure. Crewing levels are to low for this to happen effectively!” (Cabin Crew – UK)

3.12 Standards for Instructors

The following comments indicated that there appears to be a high degree of variability in the standard of fire training instructors. Since training quality depends heavily on the instructors' training skills, consideration should be given to establish a set of standards for fire training instructors.

"I have experienced a wide range of fire instructors training skills ranging from excellent to poor (technical knowledge of the subject has always been high)." (Instructor – UK)

"Standard of Recurrent Training varied greatly from airline to airline, and from instructor to instructor, in my experience." (Flight Crew – UK)

"Generally the average student will take on board this info readily, however the information that is used can often be out of date and sometimes incorrect. I worked with several airlines all of which had very differing standards for their staff." (Instructor – UK)

"The practical training is carried out by cabin crew trainers but I feel it should be carried out by fire fighting professionals. It also fails to realistically simulate our unique firefighting environment." (Flight Crew – UK)

"If done 'in house', that is by the airline itself, training is usually rushed and devalued. If done by outside contractor, training is usually to a higher standard." (Flight Crew – UK)

3.13 Other Suggestions for Improvements

Regulatory requirements and standardisation of training programs and instructors' skills

"Sufficiency of theoretical training depends upon the operator's training program and the skill set of the instructors. More detailed oversight agency guidance should be provided regarding topics for instruction for standardization across the industry. An example would be learning points for fighting a hidden fire, light ballast fires, etc, to ensure that as many eventualities are covered." (Inspector Cabin Safety – North America)

"There needs to be an international standard in regards to fire fighting, written procedures and training requirements. The standard needs to be mandated in order to 'force' operators to spend the money on the standard. Training must be conducted in a realistic environment i.e. cabin/galley simulator with smoke etc in order for the crew to see and feel the reality of fighting fires in a confined space with limited resources. This will also give instructors the chance to conduct a proper assessment of the crew members' ability to fight fires, and the suitability of their standards." (Cabin Safety Inspector/Ex-cabin crew – Pacific Islands)

"More hands on training would be worthwhile. Enhanced regulatory requirements for such training would be a safety improvement. Standardization in training norms and courseware also would be effective." (Inspector Cabin Safety – North America)

Proportions of theoretical and practical training

"35% is Theory & 65% is hands-on in a Real Fire Fighting Trainer (RFFT) and replica scenarios in the Emergency Evacuation Simulator. The result is effective. In our case, realism is the driving thought. Maximum realistic fire training needs to be provided to enable crew acquire the knowledge, skills and ability to deal with any fire confidently." (Instructor – Middle East)

"... I am increasingly concerned with the emphasis on theoretical training of cabin crew in all areas and the lack of practical training. Recognising that the smaller operators do not have a cabin mock-up at their disposal and that the fire training is completed in a half-day at a location such as [...], this of course has barriers with

effective practical training. We have carried out 14 cabin crew courses for an operator this year in the UK and many of the cabin crew were experienced and had worked for several UK operators. I was shocked at how little practical training was included in their previous courses - simple stuff such as practical exercises and scenarios in a classroom environment are not encouraged or explored - the emphasis is passing exams - if you do not have a 'real' toilet door - the improvise with the classroom door - use a box as an oven - it does not matter but the PRACTICAL learning takes place. I have met many cabin crew who can get 100% in their exams but when give a practical situation to deal with, the training and knowledge goes out the window. Instructors do not use class delegates as a feedback tool to help with the debrief following an exercise - sizes of classes are getting bigger and the excuse seems to be that there is no time to carry out any more practical training. This is the situation for all elements of training I believe but of course in a fire situation we are talking about very critical situations. To quote one operator - 'why can we not have 50 in a class? If you are a heart surgeon you will learn in a lecture and observe and then you have to get on with it - there is no practical training as such.' This attitude is an extreme one but very worrying if it was to become the norm... Powerpoint presentations are not practical training tools or lesson plans - they seem to be the driver behind the training sessions in many cases - cut them down and every afternoon session on a training course should be purely practical!" (Instructor – UK)

Differing firefighting skills

"There should be at least two crewmembers taught in advanced fire fighting skills to be carried on each flight. This would enable more confidence & ownership in the event of a fire. By airlines designating responsibility to each crew member does not guarantee a fire will be dealt with effectively." (Cabin Crew – UK)

Training with larger, real fires

"More time would be beneficial and larger more severe fires would improve the experience." (SEP Manager – UK)

"From 8 years of flying I believe crew should be shown and taught how hot fire can be, and also be shown how to deal with larger flames than those often used on training." (Cabin Crew - UK)

"I had worked as a flight attendant for 25 years. It was not until I went to a cabin fire fighting course in Atlanta, GA [...] did I get a real sense of what it would be like to be in a cabin fire. To actually be in a charred cabin, with seats on fire and seeing how a fire burns (not in a video) you then see how critical your fire fighting skills have to be, and how important your equipment is." (Inspector - Cabin Safety – North America)

Training for locating fires

"... Also it would be helpful to teach everyone the types of smell. Burning fabric is different from plastic is different from paper etc. Sometimes it would help the flight crew to know exactly what type of fire/overheating has/is occurring." (Flight Crew – UK)

Training for hidden fires

"Our discussion in CRM involves photos of interior panels being removed, of wiring and cable runs behind panels, and how to remove panels and/or use the fire axe effectively to gain access." (CRMI Training/Standards Pilot – North America)

"The part of the fire training that we conduct is onboard the aircraft this gives them a better understanding of the actual locations of electrical equipment, circuit breakers, where the bundles of wires are located behind bulkheads and panels, but limits our ability to conduct realistic fire fighting training." (Instructor – North America)

Psychological aspects of training

"Better understanding of psychological needs of participants (fire = mostly related to 'fear, stress', etc) in order to improve the performance and stress reduction during in-flight fires and/or training sessions." (Cabin Crew, Instructor, and Cabin Safety Investigator – Non-UK Europe)

"One of the issues I address in training is Instructors taking the class through an exercise, will discuss the things that went wrong and they consider the exercise a success. I ask them to discuss the things that went wrong and have the class re-do the exercise or have a second exercise in place. It is crucial that students get positive reinforcement through positive action. NOT discussion." (Inspector - Cabin Safety – North America)

Fire drills in pre-flight briefing

"...During pre-flight briefings, fire is covered in SEP most of the times, in order to keep all of us not only aware, but ready for any situation that may arise." (Cabin Crew – UK)

"I believe that the procedures should be refreshed every time we have briefing before flights." (Cabin Crew – UK)

"Pre-flight safety questions should always include fire and drills questions." (Instructor – Australasia)

Cabin crew selection criteria

"Good instructor teaching skills and personal experience. Good training should ensure appropriate understanding from the trainee. Unfortunately the average Cabin Crew is not the same as it was years ago (when the grass was greener). Some are not 'bright' enough these days to be CC, nevertheless they are hired." (CAA Inspector/Ex-instructor – Non-UK Europe)

"More time, more experience, less "low-cost" excuses. Too young staff lacking in life experience, i.e. minimum legal age as shortage of crew." (Cabin Crew – UK)

Forum/workshop for instructors

"It might be a good idea with a web site for instructors where we could share information regarding equipment etc. used during fire training." (Instructor – Non-UK Europe)

Other methods for cabin crew coordination

"Use of a code word (example: "safety unit" to aft galley) to avoid inappropriate disclosure to passengers is a very strong procedure. The public address system can be used, which provides immediate and simultaneous notification to all members of cabin crew, and permits all crewmembers to co-ordinate. The code word does not notify passengers of the nature of the emergency to avoid panic." (Aviation Safety Inspector-Cabin Safety – North America)

"Our operating manual rules say that in case of fire, we must call for help by interphone, in a conference call in [Aircraft Type] aircraft, but I think is more efficient to call by PA, because [it] is not usual [to] hear that kind of call during a regular operation." (Cabin Crew – Non-UK Europe)

3.14 **Conclusions – Online Cabin Crew Fire Training Survey**

Duration of theoretical training

- 1 It appeared that the time spent on theoretical fire training in the UK was considered sufficient by the majority of respondents; however, although not required by JAR-OPS, some UK respondents would like to receive (more) theoretical fire training in Recurrent Training.

Duration of practical training

- 2 Most UK respondents with in-flight fire experience (51.4%) felt that the amount of time spent on practical training was too short, whereas most UK respondents without in-flight fire experience (56.4%) felt that it was sufficient.
- 3 Based on the comments received on the subject, the short duration of practical training and/or large class sizes that might be experienced in some training facilities might affect the quality of the practical training. This tended to result in only a small number of fire scenarios being practiced with a lack of, or no attention, given to individual performance.

Adequacy of training for fire behind panels

- 4 Overall, the theoretical training for fires behind panels (hidden fires) was considered adequate by UK respondents. However, respondents who strongly agreed that training was sufficient were most likely to have had practical as well as theoretical training, relating to this threat. The less positive responses frequently cited the lack of practical training. Comments received suggested that crew confidence would be increased by conducting appropriate practical training on this type of fire threat. In addition, it was suggested that it would be valuable to improve cabin crew knowledge on the systems contained behind aircraft cabin panels.

Adequacy of training for multiple, simultaneous fires

- 5 The survey found that most UK respondents felt that the training for multiple, simultaneous fires was not adequate. Most respondents stated that no training on this subject, either theoretical or practical, had ever been carried out.
- 6 Some respondents were concerned that no guidelines exist for multiple fire events, in particular for aircraft with a small crew complement. The comments received on this subject also indicated that some cabin crew perceived the 'Firefighter – Assistant Firefighter (Coordinator) – Communicator' concept as their only course of action, even when not feasible (as with the small crew complement operation).

Adequacy of training for any fire visible in the cabin

- 7 According to the results of the survey, training for fires visible in the cabin appeared to be considered adequate for most UK respondents.
- 8 Based on the comments, consideration might need to be given to exposing cabin crew to a wider variation of fire scenarios during the practical training than at present. Comments received indicated that most practical training only focused on two or three typical fire types. One UK instructor suggested alternating different fire scenarios each year, in order to broaden cabin crew firefighting skills.
- 9 Many comments received indicated the need for more practical training on IFE fires and lithium battery fires.

Adequacy of training for management of passengers

- 10 Based on the comments received, it appeared that in judging the adequacy of their training for management of passengers, some respondents took into consideration the many constraints and the perceived limited effectiveness related to this type of training. The overall weak attitude of UK responses towards the adequacy of this training indicates that there is a need to improve the training, or at least standardise it.

Adequacy of the frequency of practical fire training

- 11 It was found that respondents with annual practical fire training generally regarded their training interval as being more appropriate for skill retention than a 2-year or 3-year interval. In general, respondents with in-flight fire experience displayed more negative attitudes towards less frequent practical fire training than those without in-flight fire experience.
- 12 It is apparent that the maximum interval of three years for practical recurrent fire training, as stipulated by JAR-OPS 1, was perceived by UK respondents to be of insufficient frequency. A respondent suggested more frequent training was needed for newly qualified cabin crew members followed by a longer interval after more experience was gained. Further investigation may be required to investigate the feasibility of this concept.

Realism of fire conditions during training

- 13 The results of the survey suggested that the attitude of UK respondents, without in-flight fire experience, towards the realism of fire conditions during training was somewhat positive, whilst the attitude of UK respondents with in-flight fire experience was negative.
- 14 UK responses on the realism of fire conditions during training were likely to be influenced by variations in company/training provider's training practices and facilities, respondents' opinion on the restrictions of Health & Safety regulations, and respondents' lack of reference for comparison. However, because not all respondents submitted comments to explain their answers, it was not possible to quantify the extent to which each of these factors influenced their perception.
- 15 The results of the survey indicated that consideration might need to be given to standardising the fire conditions used in practical training, which should include minimum fire intensity, fire type/source, and the use of gas-powered fires.
- 16 Some respondents who have had practical training with fires fuelled by combustible materials or flammable liquid suggested that training with these types of fires offered learning points that might not be achieved by using gas-powered fires.

Realism of smoke conditions during training

- 17 The survey suggested that the attitude towards the realism of smoke conditions experienced during training of UK respondents without in-flight fire experience was more positive than that of the respondents with in-flight fire experience. Based on the comments received, it appeared that respondents' judgement on the realism of smoke conditions during training were not just based on the level of visibility, but also on the conditions of the smoke training facility, and the scenarios in which smoke was used.
- 18 Comments received relating to the drills used in smoke training suggested that further consideration might need to be given to both the manner of the training and the required workload in order to ensure that the objective of the smoke training was achieved.

Similarity of equipment used in training with the equipment on board aircraft

- 19 The survey found that overall UK respondents had a fairly positive attitude relating to the similarity of equipment used in training with the equipment on-board the aircraft.
- 20 Based on the comments made on the standard of the PBE used in training, there was a general concern expressed by some respondents regarding the condition of the equipment used in training (e.g. missing/loose neck seal) and their not having practical training in removing the PBE from its packaging.
- 21 Other elements of firefighting equipment that some respondents did not think was adequately replicated in training were the Halon fire extinguisher integral seal, firing mechanism, and extinguishing mechanism. A few respondents suggested that the use of videos might be useful in demonstrating these differences.

Adequacy of fire training facility

- 22 Although UK respondents were generally quite positive about the representative nature of their fire training facility to an aircraft cabin, comments indicated that there was a high variability in the standard of training facilities. Some fire training facilities involved open-air constructions bearing very little resemblance to an aircraft cabin.
- 23 Based on the comments, it appeared that some respondents felt that there was an advantage in carrying out their practical fire training in a cabin mock-up, rather than in an open-air facility. Some respondents stated that they would like to use cabin mock-ups that were more representative of their aircraft type for training in locating firefighting equipment.

Relevancy of training scenarios to aircraft operation

- 24 UK respondents were overall quite positive about the relevancy of fire training scenarios to their aircraft operation. Some comments highlighted the need to have the means to ensure that training provided by the 'third-party' training organisation conformed to the operator's training requirements and operating procedures.
- 25 Some comments suggested that fire training in a cabin mock-up should be used not just for training in firefighting techniques, but also on the communication/coordination procedures and other aspects such as locating fire, locating and removing firefighting equipment, and passenger management. Respondents also suggested training in firefighting while using the appropriate protective equipment such as fire gloves and PBE.

Relationship between procedures in training and in crew operating manuals

- 26 The survey suggested that the overall attitude of UK respondents on how the procedures taught in fire training corresponded to the procedures in the crew operating manual was positive. However, the comments also indicated that, when a 'third-party' training organisation was used, all parties involved should ensure that the training provided was more specific to the operator's needs and that 'third-party' instructors were knowledgeable of the drills and procedures used by the operator.
- 27 Some comments highlighted the concern on the very prescriptive nature of the 'Firefighter – Assistant Firefighter (Coordinator) – Communicator' concept and its training. It was suggested that it might dissuade cabin crew from using their common sense and judgement in situations where there was a real fire threat which could be of an unpredictable nature.

Procedures for communication and coordination between flight crew and cabin crew

- 28 The responses indicated that most of the UK respondents, with and without in-flight fire experience, were positive about the procedures for communication and coordination between flight crew and cabin crew. However, many comments received on this subject highlighted the desirability of cabin crew and flight crew carrying out joint practical training involving communication and coordination procedures. It was considered that this would enhance the crew's understanding of their relative roles, their responsibilities and the workload imposed on each of the crew members during an in-flight emergency.
- 29 Some respondents suggested that they would like to practice communicating with flight crew whilst wearing Protective Breathing Equipment. A few comments expressed the concern of the lack of procedures for communicating with flight crew in the event of an inoperative interphone system.

Procedures for communication and coordination between cabin crew

- 30 The survey found that the overall attitude of UK respondents on the appropriateness of the procedures for communication and coordination between cabin crew was positive. However, there was an indication that more attention should be given to this aspect in practical training, particularly in relation to communicating whilst wearing PBE.

Other issues

- 31 In almost all of the subjects addressed by the survey, respondents without in-flight fire experience exhibited a more positive attitude towards the training they received, than respondents with in-flight fire experience. This could suggest that those without in-flight fire experience might lack awareness of the demands that might be placed on them during an actual fire/smoke event. A factor that was likely to influence this was that the difficulties that might be encountered during an in-flight fire were not reflected during fire training.
- 32 Some UK respondents without in-flight fire experience stated that they found it difficult to assess the adequacy of their training and/or facilities. This could be an indication that some cabin crew might not receive adequate information on actual in-flight fire/smoke accidents/incidents during their training, and/or that the differences between training and actual aspects of in-flight fire were perhaps not (sufficiently) addressed.
- 33 Many comments from UK respondents highlighted the concern that there was a lack of criteria to ensure that each crew member was proficient in firefighting skills and knowledge. Additionally, some comments indicated that some instructors had a lenient approach in dealing with trainees who did not exhibit the required level of proficiency. This issue appeared to be of concern to many respondents. A lack of proficiency in crew members would also adversely affect confidence in each others' ability which would be detrimental in an emergency situation requiring co-ordinated efforts and team work.

- 34 There was concern raised by some UK respondents that the urgency of response to an in-flight fire/smoke occurrence was not sufficiently stressed during theoretical and practical training. Respondents' suggestions on the use of accident/incident videos during theoretical training and highlighting the time the crew might have to respond to an in-flight fire before it became uncontrollable might be of value in emphasising this issue. In practical training, consideration may need to be given to timing the cabin crew's response time to emphasise the urgent nature of in-flight fire threats.
- 35 The comments received from crew of smaller aircraft types highlighted the need to have in-flight fire procedures that specifically catered for single cabin crew operation.
- 36 The survey found that there appeared to be a high degree of variability in the standard of fire training instructors. Since training quality depends heavily on instructors' training skills, consideration may need to be given to establishing a standard for fire training instructors.

4 Fire Protection Training in Non-Civil Aviation Environments

Current fire protection training in non-civil aviation, difficult to escape situations was compared with fire protection training in the civil aviation environment. This task involved visiting the training facilities and observing the training activities of:

- 1 Submarine/Ship Crew Fire Training at Royal Navy – HMS Raleigh, Torpoint, Cornwall
- 2 Air Crew Fire Training at Royal Air Force – Brize Norton, Oxfordshire
- 3 On-board Crew Fire Training at the Eurostar Engineering Centre, Temple Mills, Leyton, London

4.1 Submarine/Ship Crew Fire Training at Royal Navy – HMS Raleigh, Torpoint, Cornwall

4.1.1 Type and frequency of fire training

Prior to joining their ships/submarines, all new entrants have to undertake the Basic Sea Survival Course, which is valid for 4 years as long as they remain on board their respective ships or submarines without incurring more than a one year gap, which would result in their having to undergo the training again. As part of this course, all new entrants are required to do 0.5 days of firefighting training, which consists of 1 hour of theoretical training and approximately 2 hours of practical training.

After 4 years, all crew are required to undertake the Intermediate Sea Survival Course, where they will be given approximately 3 to 3.5 days of fire training. This training is required every 4 years, or every time a crew member joins a ship/submarine.

All crew are required to undertake a refresher course if they have not been at sea for more than 1 year.

In between these periods, when on the ship/submarine, drills on procedures and techniques are carried out constantly on-board. Training on the interface with the fire department on the harbour is carried out in monthly to two-monthly intervals depending on the ship's schedule. Every month there will be a briefing on various subjects for all crew, including firefighting procedures.

Additionally, there is an Advanced Course for selected crew members, which involves fire training for instructors, search and rescue, escape from dark and low visibility conditions, attack party leader training, and more practical firefighting training. The course duration is 5 days.

Pass/Fail Criteria

There is no examination in any form, during any of the different stages of fire training. Qualification is earned upon completion of the course.

Training Providers

All Royal Navy courses are delivered by serving members to ensure continuity and currency in training; however, these are strongly supported by civilian partners. The fire training is provided by a mixture of Royal Navy and civilian instructors from a training organisation, specialising in naval and maritime training, who also supply training for commercial customers. The organisation delivers firefighting training support to the Royal Navy and other armed forces personnel via a Private Finance Initiative (PFI) with the UK Secretary of State for Defence. Under the umbrella of this 20-year PFI arrangement, the organisation works closely with the Navy and Strathclyde Fire Brigade to deliver training. The organisation has an office in HMS Raleigh, and works closely with the Royal Navy in formulating the training contents.

4.1.2 Firefighting procedures on-board

Each submarine has a stand-by firefighting team consisting of 20 crew members (the "Standing Sea Emergency Party" or SSEP). The team is equipped with full firefighting gear including Extended Duration Breathing Apparatus (EDBA). They are trained in using fire hoses in addition to using "first aid equipment" (hand held fire extinguishers). On the ships, drills are carried out once a week.

The SSEP team is only required as a second phase firefighting effort, i.e. when the fire could not be extinguished with "first aid equipment" by the person who first discovers the fire. One of the instructors mentioned that 95% of fire occurrences on board Royal Navy ships/submarines were extinguished using the "first aid equipment", and this was emphasised to the trainees.

If the fire could not be extinguished by the SSEP or the available fixed fire protection system, the ship/submarine will then go to emergency stations.

There are at least six crew members that have undergone the Advanced Course on-board each submarine. They are called "Experts".

The "first aid" procedures following the discovery of a fire are as follows:

- Raising the alarm continuously until it is broadcast by the main ship broadcast system.
- By voice: Fire! Fire! Fire! Fire in the ... (common name e.g. galley or location marking)
- By other noises/any method available
- If fire is behind a door or hatch, leave it shut, guard door, and wait for Experts or SSEP.
- If door or hatch is opened, extinguish using first aid equipment with appropriate procedures.
- If beaten back by smoke/heat/flames, shut door or hatch, stay at the scene, brief SSEP and Incident Commander.

4.1.3 Firefighting equipment on-board

Firefighting equipment on-board the ships/submarines consists of:

- 1 9-litre Aqueous Film-Forming Foam (AFFF) fire extinguishers with hose and diffuser - Ships/submarines usually have the facility to recharge them on-board
- 2 9 kg Dry Powder fire extinguishers - There is no facility to recharge them on-board.
- 3 2 kg CO₂ fire extinguishers with horn or bayonet fittings
- 4 6-litre Wet Chemical Extinguisher (mixture of carboxylic acid, salt and water), specifically used for cooking oil fires in the galley
- 5 Centre-Fed Hose Reel (CFHR), which is the primary firefighting equipment for submarines

There is no Halon handheld fire extinguisher – Halon is only used in the fixed fire protection system.

The equipment used in training is the same type as the equipment carried on the ships/submarines.

The breathing device used by the SSEP team is a type of an Extended Duration Breathing Apparatus (EDBA), which is a piece of breathing equipment commonly

used by firefighters. Due to its size and complexity, this breathing apparatus is unlikely to be practical for use in civil aviation.

Another breathing device type available on-board is the Emergency Escape Breathing Device (EEDB), which is only intended for emergency evacuation. This breathing device would not be practical for use by civil aviation cabin crew, because it requires breathing through the mouth (i.e. does not allow verbal communication).

Training on equipment locations and stowage is a part of the induction training undertaken when the crew joins the ships/submarines.

4.1.4 **Theoretical training**

Theoretical training in the Basic Sea Survival Course for 30 new entrants was observed. The training took place in a standard classroom with projector and chairs arranged surrounding the instructor. The firefighting equipment, discussed in Section 4.1.3 (except the Wet Chemical Extinguisher), was displayed in the classroom. The duration of the theoretical training was approximately 1 hour.

The theoretical training covered the following subjects:

- 1 Theory of fire (categories of fire – only electrical, solid fuel and oil/fuel fire were discussed).
- 2 Fire triangle
- 3 Reactions required on finding a fire
- 4 Basic firefighting equipment. The instructor covered physical appearance of each of the extinguishers, pressure, capability (duration and throw), limitations and conditions of use, handling instruction, and care after use. There was some discussion on the mechanism of extinguishment for each type of agent.

Trainees were encouraged to read “*Book of Reference (BR) 2170 Volume 1*” and “*BR 4007 Guide to Ship’s Fire Fighting*” for more detailed information.

Accidents/incidents were not discussed during the training; however, accident/incident reports, especially those with learning points (e.g. new techniques, errors/failures) were disseminated to the ships’ crew.

4.1.5 **Practical training**

Breathing Devices (Intermediate Sea Survival Course)

During the Intermediate Sea Survival course, there is a 1-hour theoretical/practical training session, in a classroom. This addresses the Extended Duration Breathing Apparatus (EDBA) - donning, checking, removing, and post use care. This training session and the training sessions carried out in the Fire Fighting Training Unit (see below) used live Emergency Escape Breathing Devices (EEDB) that were the same type as those carried on the ships/submarines.

The classroom training observed featured a video on how the EEDB works, precautions to be taken, and how to use it. The instructors discussed the common discomfort in using the EEDB (breathing warm air). EEDB training units (without an oxygen canister to top up air in the rebreather) were used in training sessions carried out in the mock-up training unit.

Open-air Fire Rig (Basic and Intermediate Sea Survival Course)

The practical training started with demonstrations of the use of an Aqueous Film-Forming Foam (AFFF) and a Wet Chemical Extinguisher on a galley fire, an AFFF extinguisher on a storeroom fire and a CO₂ extinguisher (charged with air) on a switchboard fire. Instructors also demonstrated boundary-cooling (cooling of walls surrounding the compartment affected by fire). Dry powder extinguishers were not demonstrated on fires, but one was discharged to show the coverage of the extinguisher. Handling instructions and precautions for using CO₂ extinguishers were also emphasised and demonstrated using a real CO₂ extinguisher.

These demonstrations took place in an open-air facility with gas-powered fires. It was understood that until approximately 5 years ago wood fires were used for these training sessions. Gas-powered fires are now used for environmental and practical reasons.



Figure 21 Demonstration of a Switchboard Fire Using a CO₂ Extinguisher (for Horn and Bayonet Fittings)

All trainees (in groups of 3) practiced extinguishing a galley fire and a storeroom fire using AFFF fire extinguishers on the gas-powered fire rig. The procedures practiced included positioning, removal of safety pin, and discharge pattern. Only the first group were talked through during the practice.



Figure 22 "Storeroom" Fire

Instructors manipulated the fire behaviour based on the correct and incorrect application of procedures. When all steps were correct, the instructor turned off the fire to simulate extinguishment. The consequences of the application of an incorrect agent, such as trying to extinguish an oil fire in a galley with water, were demonstrated with a simulated flare-up. Re-ignition of the fire was also simulated when the application of agent was considered inadequate by the instructor.



Figure 23 Trainees Practicing Extinguishing Galley Fire with AFFF Extinguisher

In the Intermediate Sea Survival course, additional demonstrations in operating a water hose and the application of foam on the fire rig were carried out by the instructors. All trainees in this course practiced operating the hose with water and with foam (not on a fire), prior to carrying out training sessions in the Fire Fighting Training Unit (FFTU).

Fire Fighting Training Unit (FFTU)

The FFTU is a 3-floored propane gas-fuelled simulator with compartments replicating areas found on ships. Doors and hatches are representative of those on ships, but slightly larger than those on submarines.

Artificial smoke can be used throughout the compartments, and the intensity can be controlled from thin to very dense. Lighting can also be adjusted to various intensities. The fires simulated in the compartments can be very extensive. The instructors have complete control of the fire and environmental conditions via a control room.

The operating cost of the training unit is approximately £ 12,000 per day. During the day of the observation, around 70 trainees were trained in the unit.

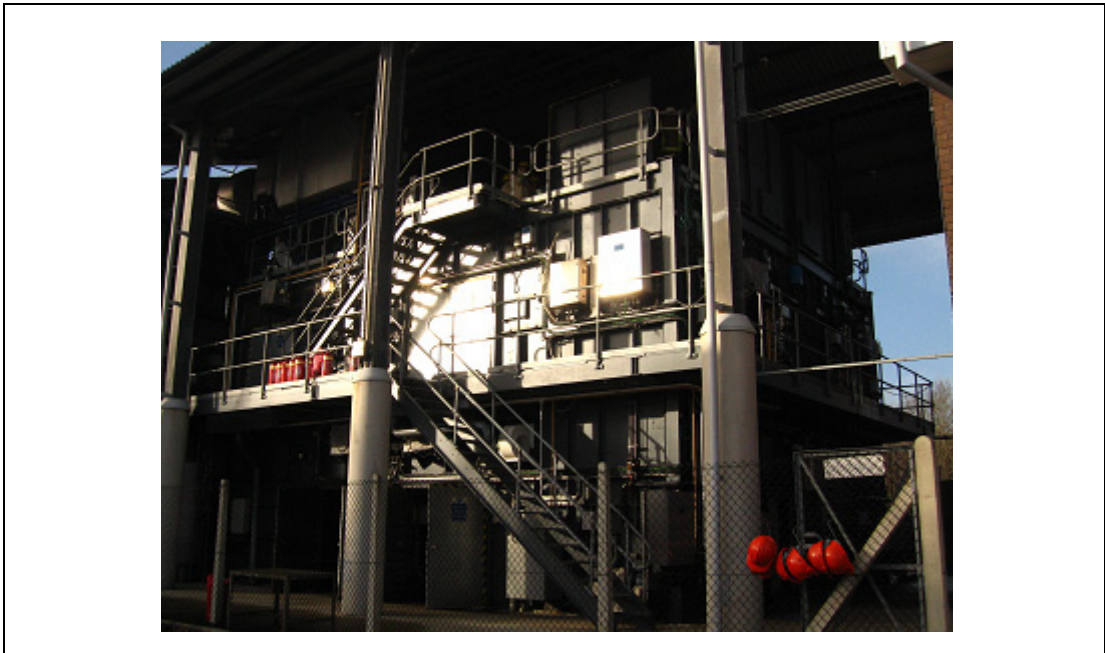


Figure 24 Fire Fighting Training Unit

The middle deck consists of a passageway with stairs from the upper deck, a mess deck (to simulate a bunk bed and a television fire), and a galley (to simulate a galley fire).



Figure 25 Galley Fire Rig and Bunk-bed Fire Rig on Middle Deck



Figure 26 Passageway with Firefighting and Safety Equipment Stowage and Television Fire Rig on Middle Deck

There is a vertical staircase connecting the middle deck and the lower deck (Figure 4.1-6). The lower deck mainly consists of an engine room and a machinery control room (Figure 4.1-7).

During the visit, two sessions in the training unit for trainees attending the Intermediate Sea Survival Course were observed. In the first session, a team of two trainees “discovered” a fire in one of the compartments and carried out the “first aid” procedure discussed in Section 4.1.2 using fire extinguishers, which were located throughout the compartments. The next team of two trainees with full firefighting gear and EDDB then entered the compartment and extinguished the fire with a Centre-Fed Hose Reel (CFHR), while the first team evacuated the unit wearing the Emergency Escape Breathing Device (EEBD). For each team, this session lasted approximately five minutes.



Figure 27 Machinery Control Room Fire Rig and Engine Fire Rig on Lower Deck

The second session in the training unit only used CFHR and EDDBA with fires that were more extensive. The session included techniques and procedures training where every trainee experienced each role in the team in different fire scenarios. For each team, this session lasted approximately 10 minutes.

4.1.6 **Conclusions – Fire Protection Training at the Royal Navy**

Many aspects of the training encountered during the Royal Navy visit are not appropriate to the civil aviation environment; however, several learning points may be applicable.

- 1 Firefighting skills and knowledge are not continually used, and are therefore likely to diminish in a relatively short period of time. Even though in the Royal Navy full formal fire training for crew is only conducted every four years, drills on firefighting procedures are carried out in a full operational environment as often as once a week. In civil aviation, a variety of safety aspects are covered during cabin crew pre-flight briefings. The inclusion of in-flight fire related procedures in such briefings on a regular basis would enhance cabin crew knowledge and preparedness for an in-flight fire event.
- 2 Ships/submarines have different levels of crew firefighting skills. This concept works well on ships and submarines due to the high number of crew, the use of various firefighting equipment with varying difficulty levels, and the possibility of very extensive fires and damages. This practice is unlikely to be practical in current civil aviation flight operations; however, it could be feasible in the future when much larger aircraft are operated with a higher number of cabin crew and complex fire protection systems.
- 3 Certain types of extinguishers or agents are not used by the trainees, during training - such as CO₂, Wet Chemical, and Dry Powder. In these instances, the instructors demonstrated the use of the extinguishers with actual agents. This gives trainees an appreciation of how the agents/extinguishers work. Since using Halon in training in civil aviation is prohibited, consideration should be given to the feasibility of using videos as an effective alternative for demonstrating the use of a Halon extinguisher.
- 4 The practical training observed at the Royal Navy integrates the use of breathing equipment in a smoke-filled environment, the removal and use of an extinguisher on a fire, and the execution of procedures in various scenarios in the mock-up. This practical training integrates all aspects of the fire training. Consideration should be given to adopting this concept in civil aviation fire training.
- 5 The fire intensity and environmental conditions used in the fire training of the Royal Navy represent worst case scenarios that they believe will enhance crew's confidence and sense of emergency.
- 6 Instructors from both the Royal Navy and the 'third-party' organisation are of a high standard. The instructors from the 'third-party' organisation are actual firefighters who are very familiar with the requirements of Royal Navy training. Instructors from the Royal Navy would have completed the Advanced Sea Survival Course with 5 days of advanced fire training. It is feasible that standards could be set for fire training instructors in civil aviation.
- 7 The training arrangement between the Royal Navy and the 'third-party' training organisation and the involvement of Royal Navy instructors ensures that the delivery of training always conforms to training requirements set by the Royal Navy.

- 8 The realism of a gas-powered fire rig can be enhanced by manipulating fire behaviour to reflect the consequences of trainees' actions (or lack of action). An accurate simulation of flare-ups/fire balls, re-ignition, and extinguishment can improve trainees' understanding of firefighting procedures. Consideration should be given to the feasibility of providing standards for gas-powered fire rigs in civil aviation fire training to ensure accurate simulation of real fire behaviour.

4.2 **Air Crew Fire Training at Royal Air Force – Brize Norton, Oxfordshire**

4.2.1 **Type and frequency of fire training**

Training on in-flight fire and smoke for aircrew is carried out in Initial Training and in the 3-yearly refresher training. The contents of this training are discussed in Sections 4.2.4 and 4.2.5.

Requirements for fire and smoke training and the associated procedures are documented in Training Orders and Instructional Specifications.

Every year all personnel have to undertake the Common Core Skills (CCS) training, which includes approximately 30-45 minutes general firefighting skills. During the CCS training, all personnel have the opportunity to practice extinguishing large, fuel-fed and wood fires with different types of extinguishers (CO₂, AFFF and water extinguishers). This fire training is not specifically designed for in-flight fires.

Pass/Fail Criteria

There are no pass/fail criteria for the fire and smoke training.

There is further training, and examination, on breathing devices as the trainees join their squadrons. The examination on this subject is a pass/fail oral examination on the specifications and troubleshooting of the unit.

There is a pass/fail examination on the locations of firefighting equipment during general safety equipment training when trainees join their squadrons.

Training Providers

At RAF Brize Norton, fire and smoke training for VC10 and TriStar aircrew is provided by the Training Flight, part of 101 Squadron. The training is overseen by the Standards and Evaluation Unit (STANEVAL) of the Operations Wing. The STANEVAL is a small cadre of highly qualified aircrew who are responsible for maintaining the flying standards of VC10, TriStar and C-17 aircrews.

The fire training element of the CCS training is carried out by the Fire Section, part of the ATC Squadron of the Operations Wing.

4.2.2 **Firefighting procedures on-board**

The procedure for dealing with the most common types of in-flight fires was discussed during ground school. The instructor emphasised that the guidelines were not the definitive answer to all situations as every fire is different. The procedure, known as the mnemonic "AAABC", is as follows:

- 1 Alert, Assess, Attack (not necessarily in this order)
- 2 Backup
- 3 Communicate

This procedure is similar to the Firefighter – Assistant Firefighter (or Coordinator) – Communicator firefighting procedure in civil aviation.

4.2.3 Firefighting equipment on-board

The VC10 and TriStar fleet carry Halon fire extinguishers, fire axes, fire gloves, smoke hood, and Mk 9 breathing apparatus.

The type of smoke hood used is the same type commonly used in civil aviation. Mk 9 breathing apparatus consists of an integrated goggle and oronasal mask and two small portable oxygen tanks that are carried over the shoulder (note: the Mk 9 breathing apparatus is not approved for use in civil aviation). Both types are available on-board and there are no specific conditions for selecting either type, except when head covering offered by the smoke hood is required.

Training on the locations of firefighting equipment is covered in general safety equipment training when trainees join their squadrons. There is a pass/fail examination on this subject. Both training and examination utilise an aeroplane cabin model representative of the actual aeroplane on an Air Transport role as shown in Figure 28.

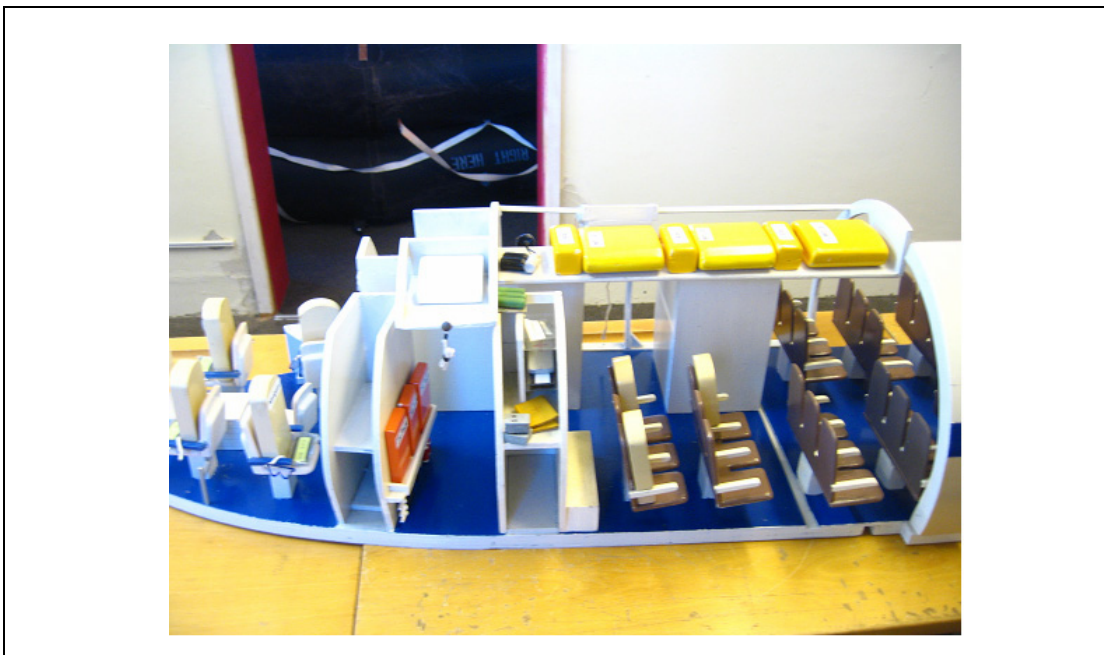


Figure 28 VC10 Cabin Model for Training/Examination in Locations of Safety Equipment

4.2.4 Theoretical training

The theoretical training (ground school) observed was attended by 6 initial trainees (2 flight crew and 4 stewards/loadmasters) and 4 recurrent trainees (stewards/loadmasters). The training was carried out in a standard classroom with projector facility. The 1-hour training session covered the following subjects:

- 1 The importance of Crew Resource Management (CRM): a 10-minute video of the Tristar Flight 163 in-flight fire accident in Jeddah was shown and learning points relating to CRM were discussed.
- 2 Fire triangle and flashover.
- 3 Types of cabin fire.
- 4 Firefighting equipment on-board.

- 5 Techniques for using BCF: serviceability of the extinguisher, application of BCF, application of cooling agent, monitoring, removal of fire debris.
- 6 Use of Protective Breathing Equipment.
- 7 Procedures for dealing with in-flight fire.
- 8 Firefighting techniques and prevention measures for oven fires, gash bag fires, overhead bin fires, toilet fires, and hidden fires.

A 20-minute video on fighting in-flight fires, which had been agreed by the UK CAA some years ago, was shown to support the training material. Procedures on dealing with toilet fires, galley fires (oven, boiler, and gash bag), flight deck fires (only very briefly), overhead bin fires, and hidden fires were demonstrated. This video also briefly covered the fire triangle, the mechanism of fire extinguishment by Halon, closed flight deck door policy, dangers of smoke, first aid, checking and monitoring, and passenger management. Additionally, continuous communication with flight crew on the location, source and severity of smoke was emphasised.

Single cabin crew operation

There are occasions when the aeroplane is operating with just one crew member in the cabin, especially when the aeroplane is not on an Air Transport role¹.

There was no special discussion on the procedures for single cabin crew operation; however, this was mentioned briefly in the video. In the video, the procedure was "inform other (flight) crew, and fight the fire". Coincidentally, both VC10 and TriStar have flight engineers, who can assist the cabin crew member in the event of an in-flight fire in a single cabin crew operation.

4.2.5 Practical training

Breathing Device

Trainees were given instruction on the use of Mk 9 breathing apparatus and the smoke hood prior to the practical training sessions in the Fire and Smoke Training Facility.

For Mk 9 breathing apparatus, instructions were given on the capacity, assembly, donning, operating, and checking. Each trainee then had the opportunity to don, check and use a live unit of Mk 9 breathing apparatus in the classroom.

Each trainee also practiced donning a smoke hood training unit in the classroom after watching the 5-minute instructional video from the manufacturer. The video explained the component, mechanism, removal from package, donning, specification, and the differences between live and training unit. Trainees had no practical exercise in removing a smoke hood from its packaging.

Smoke and Fire Training Facility

The Air Crew Smoke and Fire Training Facility is a shell replicating an aeroplane fuselage with a flight deck compartment, a single aisle passenger compartment with 8 rows of 4 seats abreast² divided into two sections by a bulkhead, a forward toilet, an aft toilet, and an aft galley area. There is a forward floor-level door, an aft floor-level door, and emergency exit hatches on both sides. There are interphones at each end of the cabin, which are used for practicing communication with flight crew.

1. When on an Air Transport role, the VC10 aircrew consists of 4 Flight Crew + 3 stewards + 1 loadmaster, and the TriStar aircrew consists of 3 Flight Crew + 5 stewards + 1 loadmaster. On a tanking sortie, the aircrew consists of 4 Flight Crew and 1 Cabin Crew.

2. As a passenger transport aeroplane, the VC10 is a single-aisle aeroplane with 4 to 6 seats abreast, and the TriStar is a double-aisle aeroplane with 6 to 9 seats abreast.

The fire extinguisher brackets installed in the Training Facility are generic. The water-charged Halon fire extinguishers are representative of the actual Halon fire extinguishers carried on-board in size, but with a slightly different firing mechanism. The pin in the training extinguisher is representative of the actual pin in term of the force required to break it. It was understood that the trainees are made aware of the differences between the training Halon fire extinguishers and the actual Halon fire extinguishers carried on-board.



Figure 29 RAF Brize Norton Air Crew Smoke and Fire Training Facility

There are usually two sessions of practical training carried out in the Facility. The first session is for training on firefighting procedures. In this session, trainees are grouped into teams of three, corresponding to the 3 roles in the firefighting procedures (A-B-C roles).



Figure 30 Galley Fire Scenario at the Smoke and Fire Training Facility

On the day of the observation, the fire scenarios used for training were a galley fire and a toilet fire. 'Firelighters' were used as the source of the fires and these created fires of small to medium intensity. No artificial smoke was generated in this session. Each trainee had the opportunity to experience one role during one scenario. During this first session, one trainee found, assessed, alerted, and attacked the fire, whilst another trainee practiced communicating location, source, and severity of fire, and firefighting progress via the nearest interphone, and another trainee donned a smoke hood training unit, prepared the back up extinguisher, and assisted firefighting. The instructor talked through the process until the fire was extinguished while other trainees observed the scenario. The duration of each scenario was approximately two to three minutes.

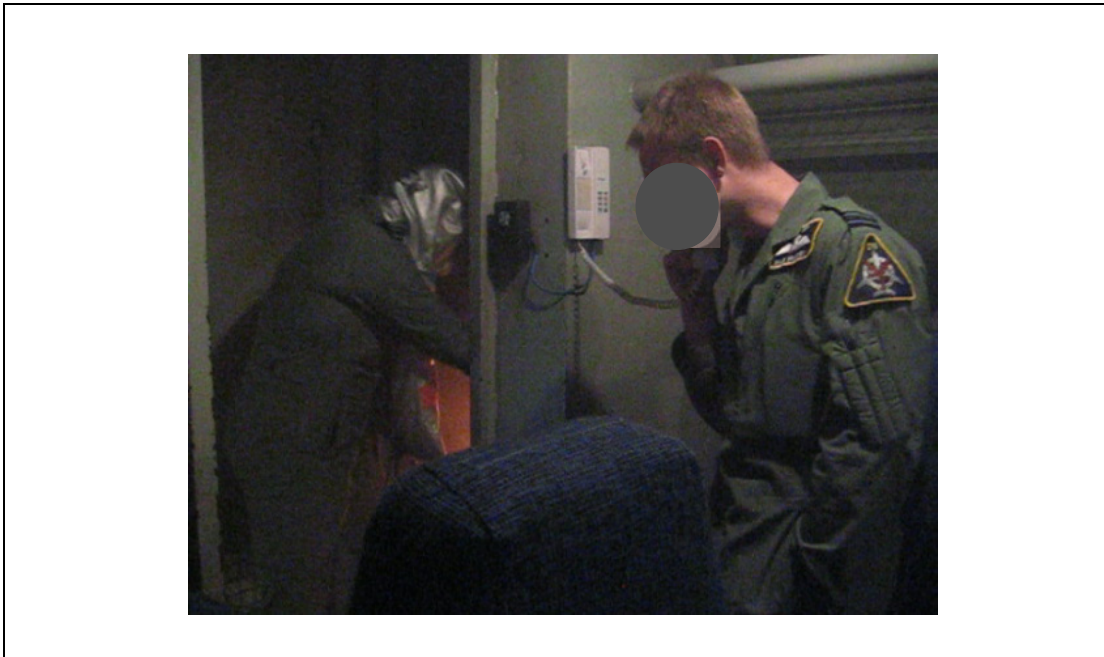


Figure 31 Toilet Fire Scenario at the Smoke and Fire Training Facility

The second session was for practicing evacuation in thick smoke while wearing protective breathing equipment, in this case the smoke hood. Before this practice session was carried out, the students were shown a video on evacuation from a research study to discuss passenger behaviour during evacuation.

The artificial smoke generated in this session was very thick, creating zero visibility throughout the cabin. The Training Facility was rotated on its longitudinal axis to replicate roll movements and the sound of panicking passengers was played back to simulate an atmosphere of emergency. After the "emergency landing", a team of 3 trainees wearing smoke hoods then carried out a search from aft of the cabin to the forward emergency exit, alerting "passengers" to unfasten their seat belts and evacuate and memorising the locations of "cold bodies" (dummies). Other trainees played the role of passengers. The duration of this scenario was approximately five minutes.

4.2.6 **Conclusions – Fire Protection Training at Royal Air Force**

- 1 Although the content and frequency of fire and smoke training at the RAF is quite similar to the common practice in civil aviation, RAF aircrew have the benefit of additional fire training as part of the CCS that is carried out annually. During this training, they have the opportunity to experience fighting different classes of fires of various intensities. Although not entirely relevant to flight operations, this experience will indeed increase aircrew's confidence in dealing with in-flight fires. It is considered that civil aviation cabin crew could benefit from practicing with actual (not gas-powered) fires.
- 2 As the RAF does not have dispensation to use Halon extinguishers in the fire training, they also have to resort to water-charged training extinguishers. The instructor compensated for this by continuously reinforcing Halon's characteristics and application techniques during theoretical and practical training.

- 3 Re-enactment videos on in-flight fire accidents with specific learning points, such as poor CRM in the TriStar Flight 163 accident, were observed to be a very effective teaching tool. Discussions included what should and should not have been done. Accident/incident videos are also used as a teaching tool by some civil aviation operators/training organisations; however, there appears to be very few of them. With the limited number of accident/incident videos, instructors can create alternative circumstances of the accident and have the trainees discuss what actions should be taken.
- 4 The practical training observed at the Royal Air Force Training Facility combined practicing the duties of each of the three roles in firefighting procedures, which included firefighting and communication techniques, use of extinguisher and use of PBE. This practical training integrated all aspects of the fire training, a concept that perhaps should be widely adopted by civil aviation fire training.

4.3 **On-board Crew Fire Training at the Eurostar Engineering Centre, Temple Mills, Leyton, London**

4.3.1 **Type and frequency of fire training**

The requirements for all training of Eurostar train crews are controlled by Eurotunnel, Network Rail, SNCF and SNCB.

Eurostar train crews consist of a Train Driver, Train Managers, and Stewards/Stewardesses. The minimum crew required to be on board in addition to the driver are two Train Managers and two Pursers, who are Stewards/Stewardesses. For a train with a full load of passengers, typically there would be a further nine Stewards/Stewardesses, making a total crew of thirteen, plus the Train Driver. If the train is operated by SNCF or SNCB, it will be crewed by two Train Drivers and one Train Manager.

The training observed on this visit involved the practical elements of refresher safety training for the Eurostar Train Managers. Refresher training for the Train Managers is required to be conducted once every two years but Eurostar currently provide this on an annual basis. The theoretical elements of the safety training for the Train Managers had been conducted the day before. The duration of refresher training for Train Managers was understood to be five days.

The training for new entrant Eurostar Train Managers takes 6 months. The first four months is a combination of theoretical and practical training, including written tests. This is followed by two months as a 'trainee' Train Manager on board the Eurostar.

This extensive training for the Train Managers reflects their important role and responsibility for the entire operation of the Eurostar apart from the Train Driver's responsibilities.

The Train Managers are divided into Train Manager 1 (TM1), and Train Manager 2 (TM2). TM1 has overall responsibility of the train and the passengers and is located in the forward part of the train. TM2 reports to TM1. TM2 is also trained to drive the train in the event that the driver becomes incapacitated. Pursers report to the Train Managers.

The training of the Train Managers also addresses track safety as well as accidents, including train derailment, and the actions needed to secure and safeguard the rail track(s).

The training also addresses the many differences in the operational requirements for the Eurostar in the UK, Belgium, France and Eurotunnel. Such differences include door operation procedures at the different stations operated by the Eurostar and the derailment procedures for each of the three countries involved in the operation.

Each year there is a review meeting involving the Training Departments of the Eurostar organisation, including Eurostar UK, SNCF and SNCB, in order to discuss any changes to regulations and requirements that might affect the training of Eurostar train crews.

Additionally, each three years, anyone who is 'tunnel trained' is required to visit the channel tunnel in order to be familiar with the tunnel infrastructure including the service tunnel facilities for evacuation.

Pass/Fail Criteria

A test paper was given at the end of the theoretical training day and the practical training day. For the theoretical paper there were some 30 questions including scenarios and diagrams of which 15 questions related to fire and evacuation (mainly evacuation). The test paper at the end of the practical training day included 15 questions of which two were in respect of safety equipment. In both cases the pass mark was 80%; there were no multi-choice question/answers.

Training Providers

Training for Eurostar crews is provided by different training organisations depending on the type of crew involved in the operation; as follows

- The UK Train Managers are trained by Eurostar UK. The UK Train Drivers are also trained by Eurostar UK, but by a different department.
- The Stewards/Stewardesses are trained by 'Momentum' which is a sub-contractor to Eurostar who provide the catering on the Eurostar trains. Momentum is a subsidiary of Italy's Cremonini Group which provides catering services on a wide range of high speed rail services across Europe.

However, it was understood that the Eurostar safety instructors train the 'Momentum' safety instructors on aspects of safety training and both organisations share the same operating procedures in order to provide operational consistency within the crews.

4.3.2 Firefighting procedures on-board

The emergency priorities if fire or smoke is discovered are as follows:

- 1 Evacuate the affected coach
- 2 Activate the fire alarm
- 3 Fight the fire (if safe to do so)
- 4 Assist any injured persons
- 5 Create a barrier coach (this will provide 2 hours protection)
- 6 Communicate with the driver
- 7 Move the passengers to a safe section of the train

4.3.3 **Firefighting equipment and systems on-board**

Firefighting equipment on-board Eurostar trains include:

- a) 26 AFFF fire extinguishers with hose
- b) 6 dry powder fire extinguishers
- c) Fire blankets
- d) Personal torches
- e) Cyalume Lightsticks
- f) Re-breather (PBE) for the train driver
- g) Half mask respiratory protective device (PBE) for the Train Managers and for the Stewards and Stewardesses
- h) Fire doors between the passenger coaches
- i) CO2 fire extinguishers at the Eurostar stations
- j) Water discharge facilities in the Eurotunnel service tunnel

There are no Halon handheld fire extinguishers carried on Eurostar trains. Halon is only used in the fixed fire protection systems for the engine compartments.

The fire extinguishers used for training appeared to be representative of the equipment on-board the Eurostar trains, but perhaps with some minor differences.

4.3.4 **Theoretical training**

This was not observed and had been conducted the day before the visit.

4.3.5 **Practical training**

There were eight Train Managers on the course that was observed and it was understood that the number of participants was usually eight or nine.

The practical training included two visits to Eurostar trains to look at emergency equipment location including ladders, systems for 'splitting' the train in an emergency and the location and use of the fixed Halon systems in the engine compartments.

The following are the two items that are relevant to the equipment carried on commercial aeroplanes.

Breathing Device(s)

The type of breathing device carried in the Eurostar passenger compartments is the half-mask respiratory protective device. The crews do not receive any practical training in the use of this equipment but are provided with written instructions on its use and the Train Managers carry a leaflet with operating instructions. The device consists of a half mask with inhalation and exhalation valves combined with a cartridge filter. The mask is packed in a sealed box with a belt clip and an additional loop. The device provides 15 minutes of protection from specified organic and inorganic gases and vapours such as Butanone, Chlorine, and Hydrogen Cyanide, as well as Sodium Dioxide and Ammonia.

There is no practical training in the use of the breathing device during either Initial Training or refresher training.

Additionally, a re-breather device is carried in the train driver's compartment. Train Drivers and the TM2's are trained to use this equipment during Initial Training and refresher training.

Fire Extinguishers

Each Train Manager handled and discharged both the 9 litre AFFF fire extinguishers with hose and the 9 kg dry powder fire extinguishers. These were discharged onto a road/pavement area inside the Eurostar facility.

No fires were used in this exercise and it was understood that the use of fires for extinguisher training had been discontinued some years ago. This was based on the fact that if a fire occurred in a Eurostar coach, and the fire could not be easily extinguished, the evacuation of the coach and the creation of a 'barrier coach' would provide up to two hours fire protection.

4.3.6 Conclusions – Fire Protection Training at Eurostar

Many aspects of the training encountered during the Eurostar visit are not appropriate to the civil aviation environment; however, the following good practice was noted:

- 1 Trainees were required to pass examinations at the end of both theoretical and practical training (with a pass mark of 80%) to demonstrate their proficiency.
- 2 Each year there is a review meeting involving the Training Departments of the Eurostar organisation, including Eurostar UK, SNCF and SNCB, in order to discuss any changes to regulations and requirements that might affect the training of Eurostar train crews.
- 3 There was a high level of co-ordination between the Eurostar safety instructors (responsible for training Train Managers and Drivers) and the sub-contract company responsible for training Stewards/Stewardesses, to ensure operational consistency within the crews.

5 Identification of Cabin Fire Threats

This task was aimed at identifying the relative frequency of occurrence of in-flight fires and the problems that were encountered by crews in attempting to combat the threat.

UK and US occurrence data and in-flight fire accidents were analysed together with the recommendations made by accident investigation authorities.

Consideration was also given to the potential nature of likely future in-flight fire threats. This aspect of the analysis is considered to be of paramount importance when considering changes to regulatory material. The development of future European aviation requirements needs to be appropriate to the future European fleet and this is likely to change significantly over forthcoming years.

5.1 Frequency and Type/Location of UK In-flight Fire/Smoke Occurrences

The UK CAA provided Mandatory Occurrence Reports (MORs) on 1575 in-service occurrences related to fire/smoke events on UK registered aeroplanes over the period of 2002-2006. Of these, 316 occurrences were considered relevant to this study and analysed further. Those not considered relevant were related to:

- fire sources outside of the control of cabin crew and included cargo compartment, brake, APU and engine fires and
- those that occurred while parked, during maintenance, or during an unknown phase of flight

Based on the number of relevant occurrences and the number of flights per year, the fire/smoke occurrence rate per million flights was derived. The number of flights per year was derived from the UK CAA Hours and Landings Database (Reference 1). Figure 32 shows the relevant in-flight fire occurrence rate per million flights in the UK over the period 2002 to 2006 inclusive. The total number of flights accumulated over this period was approximately 6,204,000.

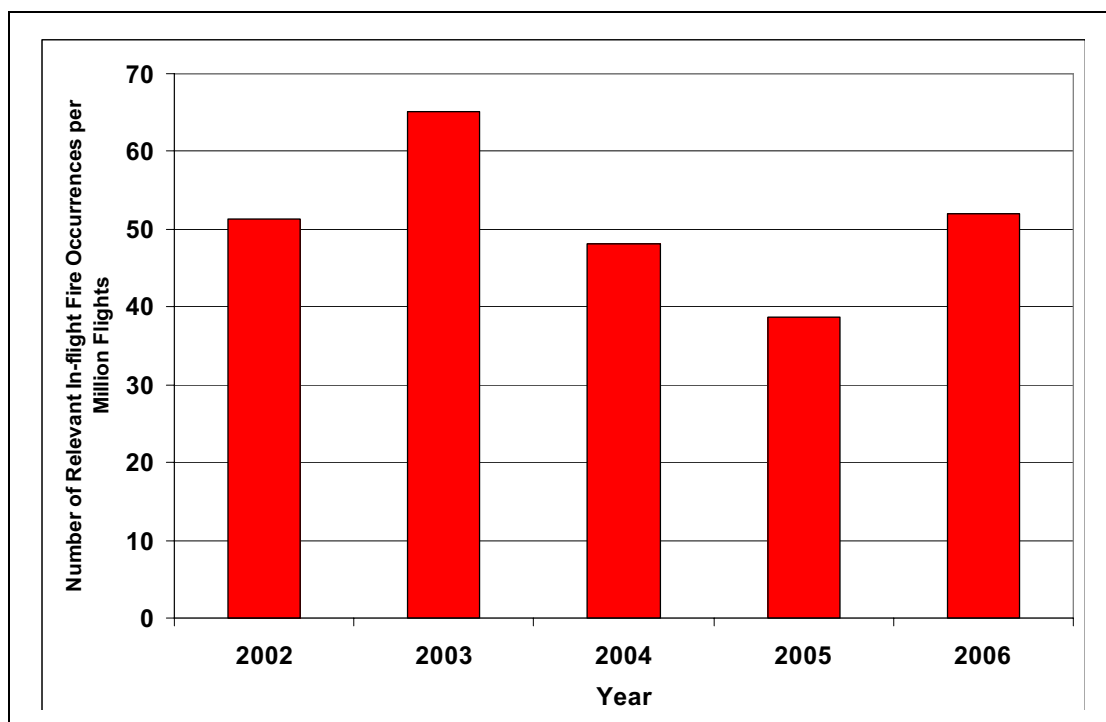


Figure 32 Number of Relevant In-flight Fire/Smoke Occurrences per Million Flights by Year

It is evident that based on these data no significant trend in the rate of occurrence of in-flight fire occurrences could be determined. However, this is as might be expected since over this relatively short period of time, the aeroplane types and operational procedures used in the UK fleet are unlikely to have changed significantly.

The MOR data for the 316 occurrences, supported by Air Accidents Investigation Branch (AAIB) Bulletins where appropriate, were analysed. For each of the 316 MORs a determination was made of the fire/smoke source location category as defined in Table 3.

LOCATION	DESCRIPTION	LOCATION CATEGORY
Behind Panels	Behind sidewall panels/ceiling panels in cabin area.	Other
Cabin - Electrical Panel	Electrical panels in cabin/galley area, e.g. Flight Attendant Panel.	Cabin
Cabin - IFE-related	In-flight Entertainment System, including monitors, speakers, control box, etc. both in passenger seats (integrated) and standalone.	Cabin
Cabin - Lighting	Any lighting in cabin area (sidewall lighting, ceiling lighting, emergency lighting, air stairs filament etc.)	Cabin
Cabin - Other	In cabin but not classified specifically, for example: girt bar/door heater, cabin area (e.g. on the aisle), passenger actions in cabin area	Cabin
Cabin – PED-related	Portable Electronic Devices such as laptops, personal audio systems, etc., portable electronic service equipment such as on board service/sales computer/printers.	Cabin
Cabin - PSU	On Passenger Service Unit (e.g. reading lights)	Cabin
Cabin - Seat/other cabin furnishing	Passenger seat cushions, curtains, carpets, etc.	Cabin
Overhead bin	Self explanatory	Cabin
Crew rest compartments	Self explanatory	Other
Under Cabin Floor	Any systems directly located under the cabin floor	Other
Galley - Chiller	Self explanatory	Galley

Table 3 Fire/Smoke Location Descriptions and Categories

LOCATION	DESCRIPTION	LOCATION CATEGORY
Galley - Other	In galley but not classified specifically, for example electrical connectors in galley, aircraft system component located in galley (e.g. water boiler), galley light unit, smaller appliances (e.g. warming plates).	Galley
Galley - Oven	Self explanatory	Galley
Galley - Trash compactor	Self explanatory	Galley
Galley - Urns/coffee makers	Self explanatory	Galley
Galley - Waste container	Self explanatory	Galley
Lavatory - Other	In lavatory but not classified specifically, for example cigarette in sink/toilet bowl, lighting unit/ballast, illuminated signs, general lavatory area.	Lavatory
Lavatory - Waste container	Self explanatory	Lavatory
Lavatory - Water heater	Self explanatory	Lavatory
Flight deck	Any components located in the vicinity of the flight deck, including windshield/windshield heating system, door lock system, instrument panels, flight displays, circuit breaker panels, seats, etc.	Flight Deck
E & E Bay	Events related to components or systems located in Electrical and Equipment Bay generating smoke that permeates into the cabin/flight deck	Other
Other	Smoke/smell/fume in cabin/flight deck caused by fire/overheat in inaccessible areas in the fuselage, e.g. cheek area, hydraulics bay, etc.	Other

Table 3 Fire/Smoke Location Descriptions and Categories (continued)

Based on the UK fleet accumulating approximately 6,204,000 flights, over the reporting period 2002 to 2006, a determination could be made of the rate of occurrence per million flights by location source as shown in Figure 33.

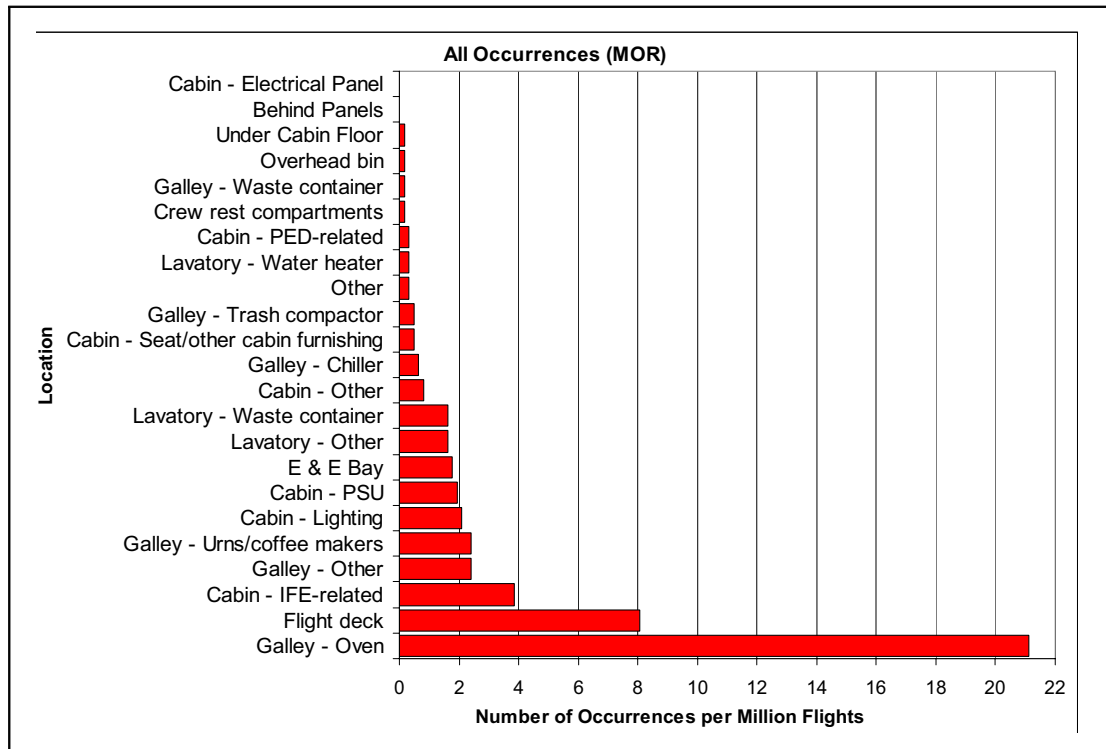


Figure 33 Rate of In-flight Fire/Smoke Occurrences Relevant to This Study per Million Flights based on UK Mandatory Occurrence Reports

It was found that 91% of the in-flight fire/smoke events relevant to this study involved electrical equipment/appliances, electrical components, and electrical wiring.

Over the period analysed, 12 fire occurrences were caused by passenger smoking in the lavatory. Cabin crew negligence/unsafe work habit was found as a major factor in oven and trash compactor/waste bin fire/smoke occurrences; it was the primary cause in 73 out of the 131 oven fire/smoke and three out of four trash compactor/waste bin fires. Typical examples of these events are as follows:

“Rear galley oven caught fire on ground as pax meals were being cooked - oven glove discovered between oven and housing. Fire discovered by cabin crew, standard firefighting procedure adopted. Flight crew informed of successful outcome with fire extinguished and cause discovered and removed. One BCF discharged, aircraft considered safe for despatch.”

“Oven, located in first class galley, started smoking shortly after being switched on. Equipment switched off and BCF extinguisher discharged into oven, smoke then dissipated. Subsequent engineering investigation found the oven contained burnt debris which would have caused a significant quantity of smoke and possibly fire...”

“The purser in the rear galley noticed a burning smell from the brewer and on investigation a tea bag was found to have burnt in the tea pot due to lack of water. The tea bag was thrown into the trash compactor and moments later smoke and fumes were noticed emanating from it. A BCF extinguisher was discharged into the compactor and the smoke/fumes dissipated. The extinguisher was later used to damp down the contents of the compactor and

the waste was removed. The purser was then briefed to make sure that any burnt items are damped down before being thrown in the trash.”

Whilst the frequency of occurrence and causes of in-flight fire events is important, the potential severity of the occurrence is of equal importance. A methodology was therefore developed for assessing the severity of the occurrence based on the following factors:

- the degree to which the fire/smoke source could be identified and accessed
- the resultant fire intensity
- the resultant smoke intensity

For each occurrence, a score was given to each of these factors and an algorithm was used to combine them to give an overall severity score for the occurrence, ranging from the lowest severity of two to a maximum severity of 41 as described in Appendix 2. Figure 34 shows the frequency of occurrence of the MOR occurrences with a severity score of 11 and above. It may be seen that there were ten locations of fire or smoke that had a severity score of this magnitude.

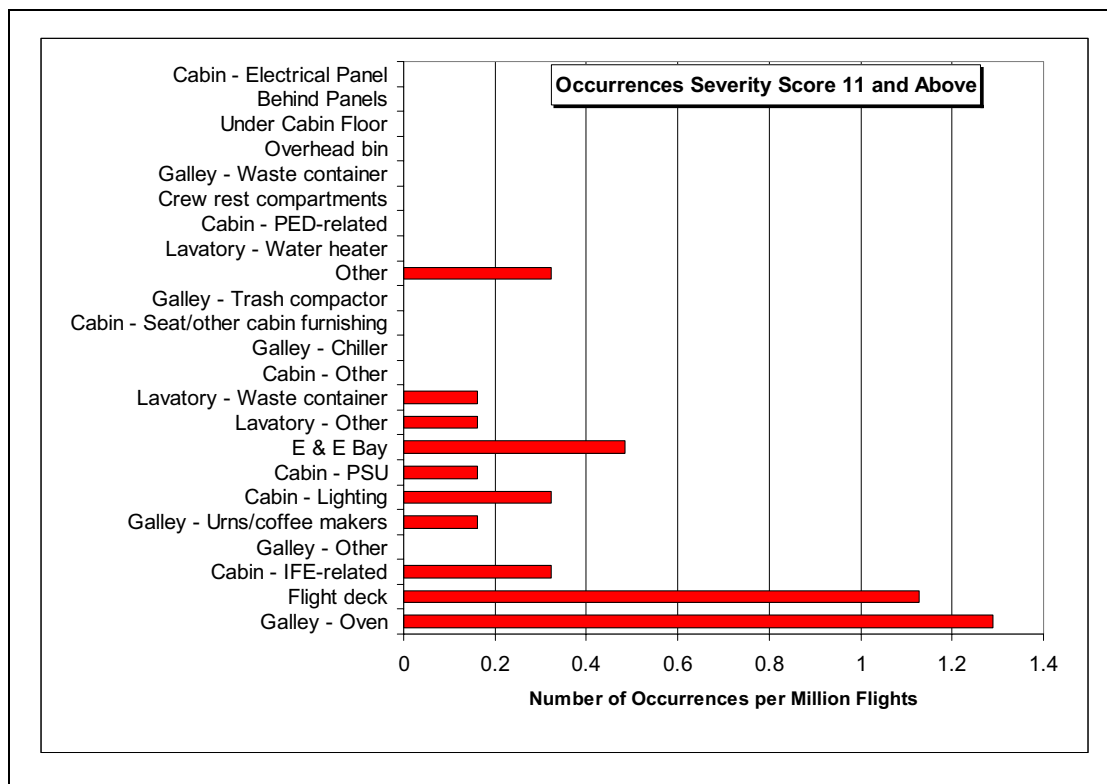


Figure 34 Rate of in-flight Fire/Smoke Occurrences per Million Flights based on UK Mandatory Occurrence Reports with a Severity Score of 11 and Above

Table 4 shows the proportion of occurrences with a severity score of 11 and above in each fire type/location.

The proportion of occurrences with a severity score of 11 and above in each fire type/location	
Other	100.0 %
E & e Bay	27.3 %
Cabin - Lighting	15.4 %
Flight deck	14.0 %
Lavatory - Waste container	10.0 %
Lavatory - Other	10.0 %
Cabin - PSU	8.3 %
Cabin - IFE-related	8.3 %
Galley - Urn/coffee makers	6.7 %
Galley - Oven	6.1 %

Table 4 Proportion of Occurrences with a Severity Score of 11 and above in Each Location Category

Figure 35 illustrates the relative frequency of occurrence of these higher severity score occurrences by location groups.

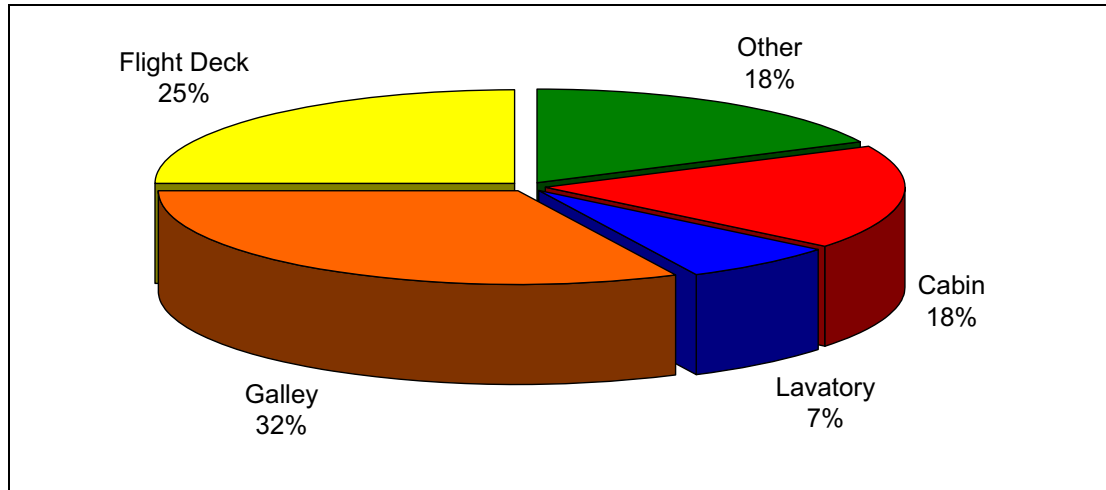


Figure 35 Grouping of Fire Locations for MOR Occurrences with a Severity Score of 11 and above

The conclusions from the analysis of the frequency of UK in-flight fire/smoke occurrences are contained in Section 5.6.

5.2 Comparison Between UK and US In-flight Fire/Smoke Occurrences

Service Difficulty Reports (SDRs) for US registered aeroplanes submitted in the year 2002, during which time the US fleet are assessed to have accumulated approximately 11,459,000 flights, were analysed and classified into the same categories as the MOR data (as defined in Table 3).

Figure 36 shows the direct comparison between the in-flight fire/smoke occurrence rates for UK and US registered aeroplanes.

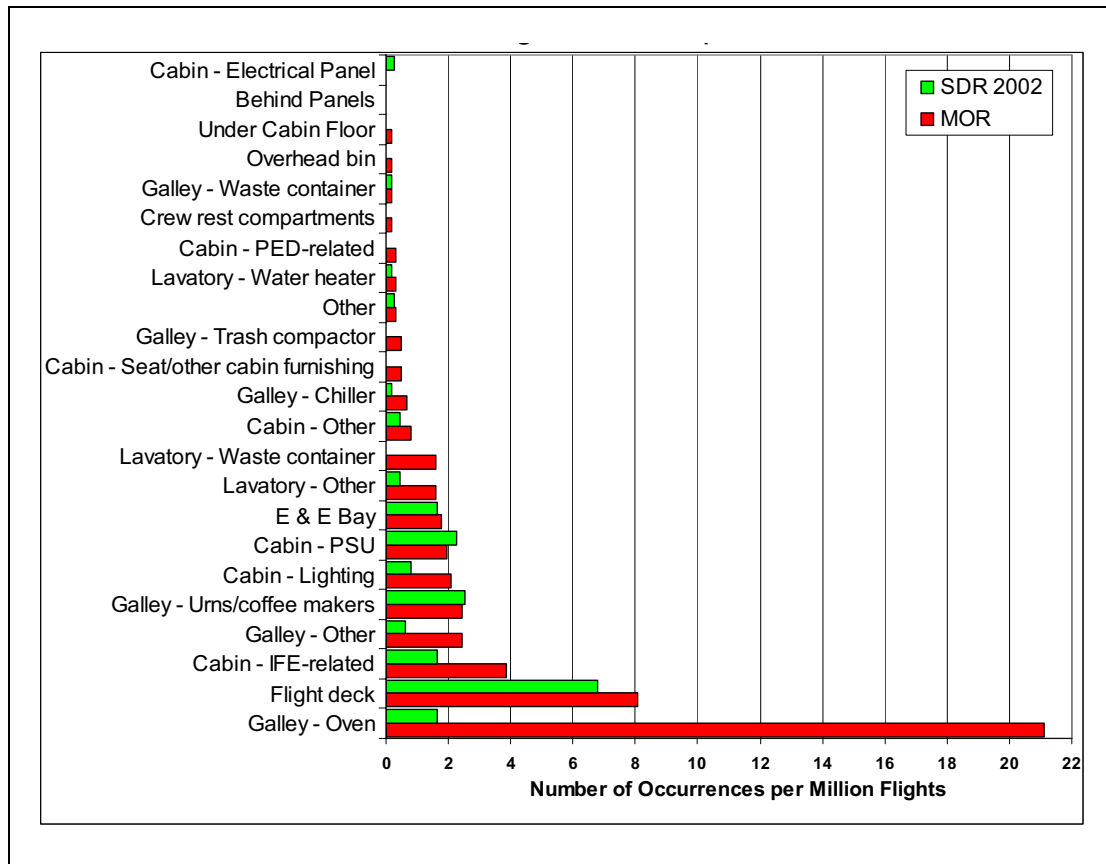


Figure 36 Frequency of Occurrence per Million Flights for Each Fire/Smoke Location – Comparison between MOR Data and SDR Data

As shown in Figure 36, there was a significant difference between the number of occurrences in several fire/smoke locations, notably Galley-Oven and Cabin-IFE-related. It was considered that the criteria specifying the need to generate a Service Difficulty Report were the primary reason for the apparent difference in the frequency of in-flight occurrences in the US and the UK. The occurrence rate in both countries could in fact be very similar but in the US, certain occurrences are not required to be reported.

FAR 121.703 requires that: "Each certificate holder shall report the occurrence or detection of each failure, malfunction, or defect concerning..."

It might therefore be expected that the SDR system is likely to result in occurrences resulting from failures, malfunctions, or defects but not those that may be attributable to human factors issues e.g. passengers smoking in lavatories or cabin crew's negligence. The UK Mandatory Occurrence Reporting Scheme as specified in CAP 382 defines the occurrences to be reported – these are primarily expressed in terms of the effects on the aircraft regardless of cause.

An analysis of the SDR and MOR data reflected this conclusion. For example, smoke/fire occurrences associated with E & E Bays and Urns/Coffee Makers had a similar rate of reporting in the SDR system as they did in the MOR system. However, fire/smoke occurrences associated with ovens, which were likely to be associated with human factors issues, were markedly different.

Table 5 shows a comparison between the in-flight fire/smoke occurrence rate, as reported in the US by the SDR system and those reported in the UK by the MOR system, for locations that were only likely to be related to failures, malfunctions and defects where there were a significant number of occurrences.

LOCATION	RATE PER MILLION	
	SDR	MOR
Flight deck	6.81	8.06
Cabin - IFE related	1.66	3.87
Galley - Urns/coffee makers	2.53	2.42
Cabin - PSU	2.27	1.93
Cabin - Lighting	0.79	2.10
E & E Bay	1.66	1.77

Table 5 Comparison between SDR and MOR Data

For the most part the rates of occurrence for the location sources shown in Table 5 were similar for US and UK registered aeroplanes. The exception to this was those occurrences related to In-flight Entertainment (IFE) and cabin lighting. The reasons for this were not evident however, average flight times of US registered aeroplanes were not as long as those of UK registered aeroplanes and this could result in the fire/smoke occurrence related to IFE systems being less prevalent. SDR reporting criteria might also be the reason of the much lower reported fire/smoke occurrences related to cabin lighting.

Another issue with analysing SDR data was most of the data had minimal description of the circumstances surrounding the occurrence.

For these reasons, the MOR data were considered most applicable to this study and comparison between operations in the two countries could not be effectively carried out on issues that had a human factors element.

5.3 Cabin Crew Problems Reported in UK In-flight Fire/Smoke Occurrences

Each of the 316 relevant Mandatory Occurrence Reports were analysed to determine whether problems were encountered by the cabin crew during smoke/fire occurrences. Forty of the MORs reported problems. One report identified two problems resulting in a total of 41. Figure 37 shows the proportion of relevant occurrences that reported problems encountered by

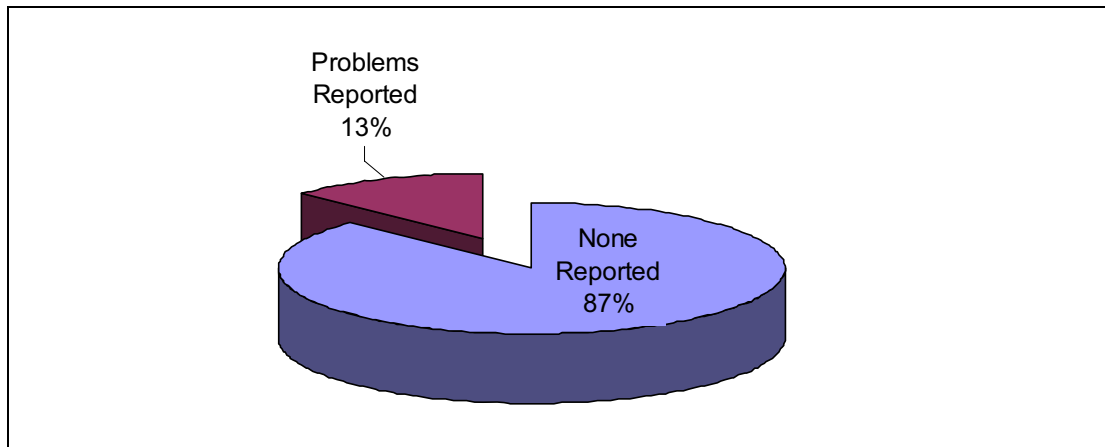


Figure 37 Percentage of In-flight Fire Occurrences where Problems were Encountered by Cabin Crew during Firefighting

It may be seen from Figure 37 that problems were reported on 13% of the occurrences. However, the proportion could be higher than this since it is likely that in some instances problems were encountered but were not reported.

Figure 38 shows the breakdown of reported cabin crew problems, and Table 6 lists the description of each problem category in alphabetical order.

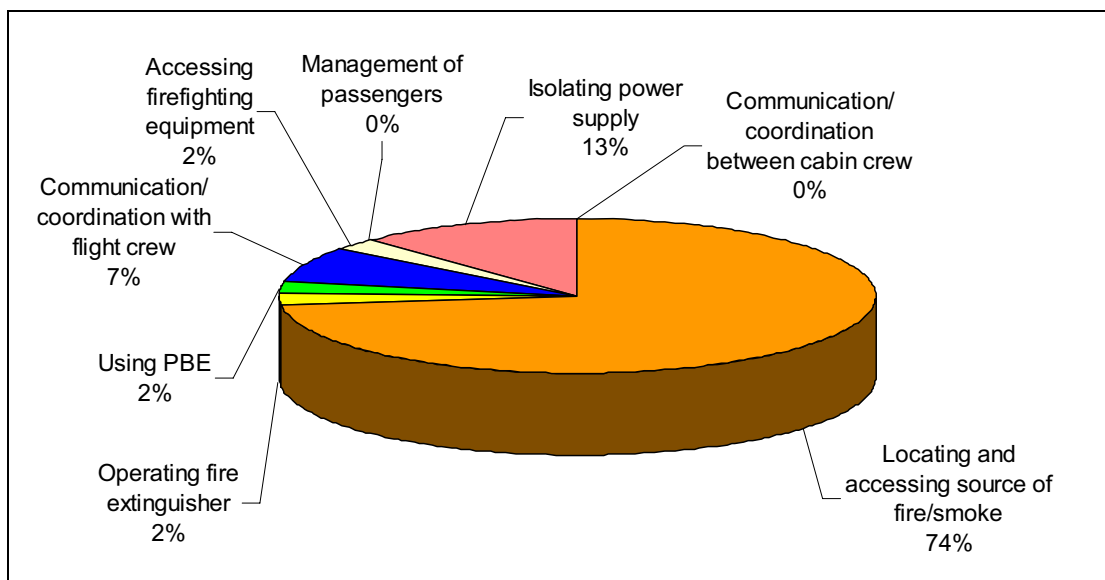


Figure 38 Breakdown of Reported Cabin Crew Problems

Problem	Description
Accessing firefighting equipment	Locating and/or removing firefighting equipment from its stowage/brackets
Communication/coordination with flight crew	Difficulties in communicating or coordinating with Flight Crew due to various reasons, e.g. communication equipment (e.g. interphone), breathing equipment, locked flight deck door policy, etc.
Communication/coordination between cabin crew	Difficulties in communicating or coordinating with other Cabin Crew due to various reasons: communication equipment (e.g. interphone), breathing equipment, etc.
Isolating power supply	Difficulties in electrically isolating or turning off the affected equipment (i.e. oven, IFE equipment), due to lack of information/training or malfunction in the isolation system
Locating and accessing source of fire/smoke	Difficulties in locating the source of smoke, determining the location of fire, and accessing fire, and accessing fire to extinguish it
Management of passengers	Difficulties in controlling passengers due to passenger panicking, communication equipment, etc.
Operating fire extinguisher	Difficulties in breaking the fire extinguisher seal, discharging the fire extinguisher, and other related issues such as Halon inhalation
Using PBE	Difficulties in removing PBE from its packaging, difficulties in donning PBE, failure of PBE

Table 6 Description of Reported Cabin Crew Problems

As can be seen in Figure 38, the three most frequently occurring problems, which constituted over 90% of those identified from the MORs, were:

- i) Locating and accessing the source of smoke/fire
- ii) Isolating power supply
- iii) Communication/coordination between cabin crew and flight crew

However, it could not be inferred from this that there were no other problems; it could be simply that other problems were not reported.

The foregoing sections give examples of each of the problems encountered as reported in the MORs.

5.3.1 Accessing firefighting equipment

Only one report related to difficulties in accessing firefighting equipment:

“Smoke from galley oven, during the cruise. BCF used. Cause found to be charring / burning of cardboard packaging used for children's meals. **Difficulty found in unclipping the BCF extinguisher**, due to the clamp being situated deep inside a box behind passenger seat row.”

5.3.2 **Communication/coordination between cabin crew and flight crew**

There were three reports identified where problems were encountered in communicating or co-ordinating with flight crew:

“At the top of descent, a strong smell, described by the reporter as being similar to that of an angle grinder, was noted in the flight deck, followed shortly after by smoke emanating from the top of the glareshield. **Oxygen masks were used by the flight crew, which the reporter notes made communication difficult with both ATC and cabin crew.** A MAYDAY was declared, with the smoke intensifying to the degree that it progressed into the cabin, and a diversion to (place) initiated. The aircraft completed a safe tailwind landing followed by a precautionary rapid disembarkation on the runway.”

“Whilst climbing through FL240 the flight crew noticed a small amount of smoke appear on the flight deck, accompanied by a smell of electrical burning. They decided to carry out a diversion but were hampered by difficulties in communications with the cabin crew and locating the appropriate checklist, since it was not clearly identified on the index page of the QRH.

Both pilots were aware of continued banging on the locked cockpit door, which had commenced after their failed attempts to reply to the cabin crew on the interphone. This heightened the pilots' concerns about what was happening, since **they were unable to either communicate with the cabin crew** or establish the cause of the smoke....”

“During approach, the Cabin Manager reported that smoke, electrical in nature, was emanating from above the water boilers in the front galley. An engineer, who was travelling as crew, investigated and isolated the electrical power to the boilers and reported that the smoke was subsiding and dispersing. Later in the approach the Cabin Manager reported a "massive water leak" from the affected boilers. The engineer returned and remained in the area during the landing to control the flood of water. Following landing it was confirmed the situation was under control and consequently a normal taxi and disembarkation was carried out. **The P1 notes the difficulty in communication by interphone alone, due to the locked flight deck door, causing a higher workload and distraction in an abnormal situation.**”

5.3.3 **Communication/coordination between cabin crew**

No instances in this category were found in the MOR data

5.3.4 **Locating and accessing source of the smoke/fire**

It may be seen that by far the most common problem encountered was locating the source of the smoke/fire. Problems of this nature were typified by the following extracts from the Mandatory Occurrence Reports:

“Approx 5 minutes after take off a 'hot' smell was evident on the flight deck. The smell was initially attributed to the air conditioning/pressurisation system and the climb was continued. Several minutes later a slight smoke haze became apparent on the flight deck, therefore the cabin was checked but found to be clear. The smoke intensity increased and appeared to be thickest in the area of the RH radio crate/circuit breaker panels. Oxygen masks were donned and an emergency declared with a request for an immediate return to point of departure. The emergency checklist was actioned and the aircraft was depressurised, after which the intensity of the smoke decreased.

A continuous haze was still present until after shutdown on stand. The aircraft was checked by the fire services and, with the use of a thermal imaging camera, a hot spot was found in the 2.30 position on the RH bulkhead close to the fuselage skin. Further investigation established that the hot spot was due to the failure of a previous operator's modification to the riser in the flight deck. The aircraft is to be returned to the original build standard and a fleet check carried out."

"During cruise white, wispy smoke emanated from the top and sides of the boiler IR04 and espresso/cappuccino machine IR05 in galley 1 and a distinctive (class E electrical) smell was evident throughout the galley, flight deck and A-zone cabin. Whilst the source was being investigated the smoke increased to a considerable amount (billowing) and all circuit breakers in above panels were pulled. A BCF extinguisher was discharged into the gaps between the boiler and panels, but after 30 seconds the smoke was still present so a smoke hood was donned and with the use of a crash axe, the espresso/cappuccino machine was levered half way out to identify the source (using a torch). A second BCF extinguisher was then discharged and finally the smoke dissipated. The area was then monitored for the remainder of the flight with no recurrence of the problem."

"During cruise at FL370, the cabin warning horn sounded. The cabin altitude was checked and noted as 10000ft. The horn was cancelled and both air conditioning packs were checked, but appeared to be operating normally. The DV valve indicated 'closed' and the pack trip reset was depressed in case there was an un-annunciated problem. With the cabin rate of climb approx 500 to 1000fpm, the cabin alert call was made for an impending oxygen mask drop. When the cabin altitude reached 12000ft and was still climbing, the pressurisation controller was set to MAN and the DV closed (with no apparent movement in the indicator). With the cabin altitude still rising, the flight deck crew donned their oxygen masks, declared a PAN and initiated an emergency descent. On closing the thrust levers, the P2 noted the rate of climb increase to 4000fpm minimum. All memory recall items were completed, the aircraft levelled at 12000ft and a diversion was initiated. On oxygen mask removal, both pilots were aware of a strong smell of electrical burning. A MAYDAY was then declared, squawk 7700 was set and the smoke/fumes QRH actions completed. Shortly afterwards, the master caution on the overhead panel illuminated with "SMOKE" and simultaneously the smoke alarm in the RH rear toilet activated. On investigation, the cabin crew reported smoke from the RH rear toilet, but with no fire apparent they stood by with a BCF extinguisher. As the a/c levelled off, the P2 noted that the cabin had started to pressurise, therefore, the DV valve was opened to depressurise the cabin. Once the cabin depressurised and after the QRH smoke drill was actioned, the smell of burning became less. Cabin crew then noticed smoke emitting from the nr3 oven in the rear galley, the oven was already switched off so circuit breakers were pulled. A straight in approach was made for a precautionary landing. After landing, all crew remained on handset and the a/c taxied to stand where an uneventful passenger disembarkation was carried out. Following engineer investigation, numerous components were replaced. These included the rear oven (wiring burnt), all chemical oxygen generators, outflow valve, coalescing bags both packs, pressurisation control panel, nr1 and 2 pressure controllers forward equipment outflow valve. Power runs carried out to prove single pack confidence, which showed low inflow on both packs. RH bleed air regulator, RH Pressure Regulating Shut Off Valve (PRSOV) and both pack flow control valves replaced."

5.3.5 Management of passengers

No instances in this category were found in the MOR data.

5.3.6 Operating fire extinguishers

Only one report related to operating fire extinguishers:

“Two ovens in the forward galley began smoking within one minute of being switched ON. The smoke was acrid but not electrical and the BCF extinguisher was discharged in accordance with the company fire fighting procedure. One member of the cabin crew became nauseous from the BCF fumes and was required to rest for the remainder of the flight and visit a doctor on arrival.”

5.3.7 Isolating power supply

There were five reports identified where problems were encountered in isolating power supply. The following are examples:

“A fire occurred in toilet 'N', located near door R4, 2 hours 30 minutes after the aircraft departed (place) for (place). A BCF fire extinguisher, discharged into the toilet compartment, extinguished the fire. The source of the fire was located in a pack of paper napkins, lying adjacent to a hot 'ballast assembly', on shelves built into an area behind the toilet vanity mirror. **The circuit breaker, J8 on panel P320 named 'LAV LIGHTS RIGHT', was identified and tripped to disconnect the electrical supply to the 'ballast assembly', however, the lighting in toilet 'N' remained illuminated.** Electrical power to the assembly was eventually removed by disconnecting the supply at the unit itself.”

*“Smoke and burning in pax cabin due to water spillage on IFE control box. Fuel dumped and aircraft diverted to (place). Passenger water was spilt between seats 8H&K causing electrical smoke & burning. **The seats were electrically isolated and master IFE cut off.** Smoke and burning dissipated and BCF not required. **On investigation and in conjunction with 'Maintrol' the seats although isolated, still had power to them.** Aircraft diverted to (place) and **engineers fully isolated seats and removed IFE control box**, which was totally burnt out and an in-flight hazard. Full seat isolation required. Canadian TSB officials confiscated control box for investigation. After this incident, the operators Cabin Safety Department put out a pamphlet with pictures and diagrams of all isolating switches on all fleets. A FCN was also issued to all crew notifying them not to reset any suspect electrical device on the aircraft after isolation even after any sign of the malfunction has disappeared.”*

5.3.8 Using Protective Breathing Equipment

Only one report related to difficulties with using Protective Breathing Equipment:

“An oven in the rear galley overheated, producing smoke. Cabin crew pulled the circuit breaker but failed to stop the smoke, consequently a BCF and a smoke hood were used although the hood failed to work. Investigation of the hood failure revealed the bar which normally activates the hood was missing, the only remaining part of the bar being a small piece of plastic on the metal oxygen tube.

An investigation has been carried out by the smoke hood manufacturer in conjunction with the Operator's Cabin Safety Manager and determined that there was no fault with the unit. Further information received (following further de-brief of the crew involved) has led QA to believe that the user may have inadvertently damaged the operating lever as a result of a perceived difficulty experienced during donning of the hood. This appears to be an issue of the

design and method of use of the equipment and discussions with the cabin crew concluded that the operational handling of the smoke hood was carried out incorrectly, which damaged the operating lever prior to donning the mask. A notice has been issued to Cabin staff emphasising the correct handling of the smoke hood and the subject has been introduced into cabin crew training sessions.”

5.4 **Issues Arising from Accidents**

A review of accident data was carried out using the following data sources:

- CSRTG Accident Database (Reference 2)
- The Flight Safety Foundation Aviation Safety Network (Reference 3)
- Accident reports contained in the RGW Cherry and Associates Limited accident report library
- NTSB Database (Reference 4)
- NTSB Safety Recommendations (see Appendix 3)

A review of these data sources revealed 20 fire related accidents to passenger carrying aeroplanes considered pertinent to this study. Details of the accidents are contained in Appendix 3. Three of these fire related accidents occurred on the ground. However, they were included in Appendix 3 since they were considered relevant to this study. Whilst they could not be considered as an exhaustive list of in-flight fire accidents, they were likely to be those that had resulted in the identification of the majority of problems encountered in combating in-flight fires.

Recommendations made by the US, UK and Canadian accident investigation authorities pertinent to in-flight fire occurrences were also studied and considered in terms of the potential problems that they were intended to address. All recommendations were considered even though their status might be closed and satisfactorily addressed. These recommendations are also contained in Appendix 3.

The categories of problems considered were those used for the analyses carried out on MOR data:

- 1 Accessing firefighting equipment
- 2 Communication/coordination between cabin crew and flight crew
- 3 Communication/coordination between cabin crew
- 4 Locating and accessing source of smoke/fire
- 5 Management of passengers
- 6 Operating fire extinguisher
- 7 Isolating power supply
- 8 Using Protective Breathing Equipment

Each of these problem categories was considered in the light of the accident data and recommendations from accident investigation authorities. The findings, from this analysis of accidents, cannot be considered as definitive but rather complementary to the analysis of occurrence data and the findings from the online cabin crew fire training survey (see Section 3.7).

5.4.1 **Accessing firefighting equipment**

No in-flight fire accidents, or recommendations from accident investigation authorities, have been identified where accessing firefighting equipment was cited as a problem experienced by cabin crew.

5.4.2 **Communication/coordination between cabin crew and flight crew**

Communication and coordination between the cabin crew and flight crew featured as a significant issue based on the analysis of MOR data and this appeared to be reflected in accident experience. Problems encountered were in some instances hardware related. However, procedural aspects also featured in the experience from accidents and this was reflected in recommendations made by accident investigation authorities.

The recommendations made by the Commission D'Enquete, France following the accident to the B-707 at Orly on the 11th July 1973 were as follows:

“Finally the Investigation Commission stresses the need for a reliable communication system and efficient operating instructions for the rapid transmission of safety communications between the flight crew and cabin personnel and vice versa, especially in wide-bodied aircraft.”

The NTSB made the following recommendations following their investigation into the accident to the DC-9 in Cincinnati on the 2nd June 1983:

“The NTSB recommends that the FAA: require that Air Carrier Principal Operations Inspectors review the training programs of their respective carriers and if necessary specify that they be amended to emphasize requirements: - For flightcrews to take immediate and aggressive action to determine the source and severity of any reported cabin fire and to begin an emergency descent for landing or ditching if the source and severity of the fire are not positively and quickly determined or if immediate extinction is not assured. - **For flight attendants to recognize the urgency of informing flight crews of the location, source, and severity of any fire or smoke within the cabin.** - For both flight crews and flight attendants to be knowledgeable of the proper methods of aggressively attacking a cabin fire by including hands-on-training ...”

With regard to the communication systems, more recently, the UK AAIB made the following recommendations following the in-flight smoke incident that occurred to a DHC-8-400 on the 4th August 2005:

“It is recommended that for all large aeroplanes operating for the purpose of commercial air transport, the UK CAA and the EASA should take steps, procedural or technical, as are necessary to improve the reliability and availability of communications between flight and cabin crews, including the reliability of communications equipment and associated power supplies in both normal and emergency configurations.”

5.4.3 **Communication/coordination between cabin crew**

Communication while wearing PBE was the main issue in an incident involving a DHC-8-400 on the 4th August 2005, which experienced a build-up of smoke in the flight deck and the cabin. The subsequent accident investigation carried out by the UK AAIB resulted in the following recommendation in 2007:

2007-006

“It is recommended that the UK CAA and the EASA review the current training requirements for cabin crew members in the use of smoke hoods to mitigate

the communications difficulties which may be encountered and to improve the ability of all crew members to communicate while wearing smoke hoods”.

5.4.4 Locating and accessing the source of smoke/fire

As may be seen from Appendix 3, improving the crew’s ability to locate and access the source of smoke/fire in an in-flight fire occurrence has been the most frequent recommendation made by accident investigation authorities. Recommendations for improving the cabin crew’s ability to locate and access fires were made by the NTSB following the accident to a DC-9 in Cincinnati on the 2nd June 1983 and by the Canadian TSB following the Swiss Air accident on the 2nd September 1998. Two of the findings of the TSB were as follows:

Finding Number 8

“There was a reliance on sight and smell to detect and differentiate between odour or smoke from different potential sources. This reliance resulted in the misidentification of the initial odour and smoke as originating from an air conditioning source”.

Finding Number 9

“There was no integrated in-flight firefighting plan in place for the accident aircraft, nor was such a plan required by regulation. **Therefore, the aircraft crew did not have procedures or training directing them to aggressively attempt to locate and eliminate the source of the smoke**, and to expedite their preparations for a possible emergency landing. In the absence of such a firefighting plan, they concentrated on preparing the aircraft for the diversion and landing”.

These findings resulted in the TSB making the following recommendations:

A00-16

“That appropriate regulatory authorities, in conjunction with the aviation community, review the adequacy of in-flight firefighting as a whole, to ensure that aircraft crews are provided with a system whose elements are complementary and optimized to provide the maximum probability of detecting and suppressing any in-flight fire.

A00-17

“That appropriate regulatory authorities, together with the aviation community, review the methodology for establishing designated fire zones within the pressurized portion of the aircraft, with a view to providing improved detection and suppression capability”.

The problem with locating and accessing fire was predominantly related to hidden fires. Following the in-flight fire on board a DC-9 in Cincinnati on the 2nd June 1983, the NTSB issued the following recommendation:

A-84-077

“The NTSB recommends that the FAA: require that Airplane Flight Manuals, Air Carrier Flight Operations Manuals, and Flight Attendant Manuals be amended to include comprehensive discussions and illustrations showing the proper use of a fire axe and the locations in each model of aircraft operated where a fire axe can be used safely to gain access to a fire or smoke emission source”.

More recently, the NTSB made the following recommendations relating to locating and accessing hidden fires following the accident to the MD-88 in Covington on the 17th September 1999:

A-01-083

“The NTSB recommends that the FAA: Issue an advisory circular (AC) that describes the need for crewmembers to take immediate and aggressive action in response to signs of an in-flight fire. The AC should stress that fires often are hidden behind interior panels and therefore may require a crewmember to remove or otherwise gain access to the area behind interior panels in order to effectively apply extinguishing agents to the source of the fire”.

A-01-084

“The NTSB recommends that the FAA: Require principal operations inspectors to ensure that the contents of the advisory circular (recommended in A-01-083) are incorporated into crewmember training programs.”

A-01-085

“The NTSB recommends that the Federal Aviation Administration: Amend 14 Code of Federal Regulations 121.417 to require participation in firefighting drills that involve actual or simulated fires during crewmember Recurrent Training and to require that those drills include realistic scenarios on recognizing potential signs of, locating, and fighting hidden fires”.

A-01-086

“The NTSB recommends that the FAA: Develop and require implementation of procedures or airplane modifications that will provide the most effective means for crewmembers to gain access to areas behind interior panels for the purpose of applying extinguishing agent to hidden fires. As part of this effort, the FAA should evaluate the feasibility of equipping interior panels of new and existing airplanes with ports, access panels, or some other means to apply extinguishing agent behind interior panels”.

In response to these and other NTSB recommendations, and following a review of accidents carried out by the NTSB, the FAA issued Advisory Circular AC No: 120-80 (Reference 12). This Advisory Circular gives guidance on handling in-flight fires and specifically to locating and accessing their source:

“Discusses the dangers of in-flight fires, with particular emphasis on hidden fires that may not be visible or easily accessed by the crew. It discusses the importance of recognizing and quickly assessing the conditions that may be associated with hidden fires and the importance of taking immediate action to gain access to fires that are located behind interior panels”.

In a letter addressed to the FAA in January 2002 (Reference 5), the NTSB made comment on the in-flight fire occurrence on board the American Airlines flight 1683 that occurred on November 29, 2000, about 1753 Eastern Standard Time:

“After takeoff, the three flight attendants saw a flash of light and heard a boom on the right side of the airplane. Flight attendant No. 1, who was seated on the forward jumpseat, saw white smoke coming from a fluorescent light fixture in the forward entry area. She shut the light off and called the cockpit. The captain told her to “pull the breaker” for the fluorescent light. She pulled the circuit breaker, and smoke stopped coming out of the fixture.

When flight attendant No. 1 went aft to check on the passengers, she observed “dark, dense, black” smoke coming from the ceiling panels above rows 7 and 8. She went to the cockpit and notified the flight crew while the other two flight attendants retrieved Halon fire extinguishers and brought them to the area near rows 7 and 8. The smoke detectors in the aft lavatories sounded. The smoke

worsened in the midcabin area, and a ceiling panel above row 9 began to blister and turn yellow.

A flight attendant began discharging a Halon extinguisher toward the blistered ceiling panel. Flight attendant No. 1 asked the passengers if anyone had a knife that could be used to cut the ceiling panel. A passenger produced a knife and cut a circular hole in the blistered area of the ceiling panel. Flight attendant No. 1 then fully discharged a Halon fire extinguisher into the hole, assessed the results, and found that the smoke appeared to be diminishing. Before taking her seat for the emergency landing, another flight attendant gave the passenger in seat 9E a Halon fire extinguisher, instructed him on its use, and told him to “use it if it was needed”. However, the smoke did not recur”.

NTSB comment on this occurrence was as follows:

“In the American flight 1683 incident, a flight attendant, working with a passenger, successfully extinguished the fire by cutting a hole in the overhead panel and applying extinguishing agent. Although this action was successful, the Board notes that the flight attendant took the action on her own initiative, not because she was trained to do so”.

5.4.5 Management of passengers

No in-flight fire accidents, or recommendations from accident investigation authorities, have been identified where the management of passengers was cited as a problem experienced by cabin crew.

5.4.6 Operating fire extinguishers

Following the accident to the DC-9 in Cincinnati on the 2nd June 1983 the NTSB issued the following recommendation:

A-84-076

“The NTSB recommends that the FAA: require that Air Carrier Principal Operations Inspectors review the training programs of their respective carriers and if necessary specify that they be amended to emphasize requirements: - For flightcrews to take immediate and aggressive action to determine the source and severity of any reported cabin fire and to begin an emergency descent for landing or ditching if the source and severity of the fire are not positively and quickly determined or if immediate extinction is not assured. - For flight attendants to recognize the urgency of informing flightcrews of the location, source, and severity of any fire or smoke within the cabin. - **For both flightcrews and flight attendants to be knowledgeable of the proper methods of aggressively attacking a cabin fire by including hands-on-training** in the donning of Protective Breathing Equipment, the use of the fire ax to gain access to the source of the fire through interior panels which can be penetrated without risk to essential aircraft components, and **the discharge of an appropriate hand fire extinguisher on an actual fire”.**

More recently, an accident to an MD-88 on the 17th September 1999 was reported by the NTSB (Reference 5). Extracts from the report of the accident are as follows:

“Shortly after takeoff, several flight attendants detected a sulphurous or “lit match” smell and reported it to the flight crew. Two off-duty flight attendants retrieved Halon fire extinguishers when flight attendants noticed smoke in the forward section of the coach cabin. Flight attendants also reported seeing an orange or red, flickering glow beneath the vent at that location.

Flight attendant No. 1 went to the cockpit to inform the flight crew of these observations and asked the captain whether to spray Halon into the vent where she had seen the glow. **The captain instructed her not to use the Halon extinguisher, indicating he was concerned about spraying Halon in the cabin. Meanwhile, another flight attendant had already discharged a Halon fire extinguisher into the vent and observed that the glow was no longer visible. Thereafter, the smoke began to dissipate and did not return, indicating that the fire had been extinguished by the Halon”.**

This occurrence resulted in the NTSB making the following recommendation:

A-01-087

“The NTSB recommends that the FAA: Issue a flight standards handbook bulletin to principal operations inspectors to ensure that air carrier training programs explain the properties of Halon and emphasize that the potential harmful effects on passengers and crew are negligible compared to the safety benefits achieved by fighting in-flight fires aggressively”.

5.4.7 **Isolating power supply**

No in-flight fire accidents, or recommendations from accident investigation authorities, have been identified where the removal of power from electrical appliances generating fire or smoke was cited as a problem experienced by cabin crew.

5.4.8 **Using Protective Breathing Equipment**

Both the NTSB and the UK AAIB have made recommendations regarding the use of Protective Breathing Equipment used by cabin crew and flight crew. These recommendations are shown in Sections 5.4.3 and 5.4.6 of this report but are repeated here for clarity:

2007-006

“It is recommended that the UK CAA and the EASA review the current training requirements for cabin crew members in the use of smoke hoods to mitigate the communications difficulties which may be encountered and to improve the ability of all crew members to communicate while wearing smoke hoods”.

A-84-076

“The NTSB recommends that the FAA: require that Air Carrier Principal Operations Inspectors review the training programs of their respective carriers and if necessary specify that they be amended to emphasize requirements: - For flightcrews to take immediate and aggressive action to determine the source and severity of any reported cabin fire and to begin an emergency descent for landing or ditching if the source and severity of the fire are not positively and quickly determined or if immediate extinction is not assured. - For flight attendants to recognize the urgency of informing flightcrews of the location, source, and severity of any fire or smoke within the cabin. - **For both flightcrews and flight attendants to be knowledgeable of the proper methods of aggressively attacking a cabin fire by including hands-on-training in the donning of Protective Breathing Equipment,** the use of the fire ax to gain access to the source of the fire through interior panels which can be penetrated without risk to essential aircraft components, and the discharge of an appropriate hand fire extinguisher on an actual fire”.

5.5 **Assessment of Future Threats**

The process adopted in this study was to identify potential future threats by brainstorming with Airworthiness Authority members engaged in fire and cabin safety research and regulation. During the brainstorming sessions, new and "altered" threats related to in-flight fire issues were identified. Only those considered as pertinent to in-flight fire issues likely to affect cabin crew training were considered further. These threats were subsequently analysed by means of literature research, which revealed other aspects of potential future threats that were considered in the study.

Increases in the size of aircraft, the length of flights and changes in the electrical equipment likely to be found in the cabin will all have the potential to change the frequency and severity of future in-flight fire threats. These issues will require to be considered in the formulation of cabin crew training programmes.

5.5.1 **Growth in aircraft size**

The number of passengers and hence number of seats being carried on aircraft is increasing – currently estimated to be in the region of 3% per annum. This is attributable to both increases in the passenger carrying capacity of aircraft in-service and an increase in the passenger load factor.

A Market survey by Airbus (Reference 6) states:

"As an inevitable response to intensifying cost pressures infrastructure capacity constraints and fast growing international markets, the composition of the world fleet will shift towards larger aircraft. By 2023 mainline single-aisles will make up 69% of the fleet, compared with 77% in 2003. At the same time very large aircraft will account for 6% of the world passenger fleet; approximately the same percentage as represented by 747s today. The role played by very large aircraft is more clearly seen in terms of capacity. By 2023, these aircraft will provide 15% of all seats in service".

A Press Release issued by the IATA in 2007 (Reference 7) states:

"The average passenger load factor hit a record 81% in July [2007], up 0.3% from the previous high in July 2006. With the exception of April 2007, monthly load factors have risen every month during the past two years. The average load factor during January-July 2007 was 76.5%, up from 76% recorded during the same period in 2006."

This growth in aircraft size and the increasing number of passengers carried on-board aircraft is likely to make problems associated with the management of passengers during in-flight emergencies more acute.

Communications issues, both amongst cabin crew, and between cabin and flight crew, will require greater consideration especially if there is an increase in the proportion of multiple deck aircraft in the fleet.

The majority of the fire types/sources identified from the analysis of MOR data (see Section 5.1) was related to the aircraft passenger capacity. As aircraft increase in passenger capacity, the potential for fires within the cabin is also likely to increase due to more IFE equipment, more Portable Electronic Devices, etc. The number of lavatories and the amount of electrical equipment contained in galleys is also likely to increase.

In summary, there is a danger that increases in aircraft passenger capacity (and hence aircraft size) could result in:

- An increase in the frequency of in-flight fire occurrences, and that
- Further attention may need to be given to crew training associated with communications and passenger management.

5.5.2 **Increase in flight time**

The length of flights has shown a consistent increase over the past twenty years. Figure 39 shows the average flight time for the western world fleet on a year-by-year basis from 1987 to 2006. An extrapolation through to 2030 is also shown in Figure 39.

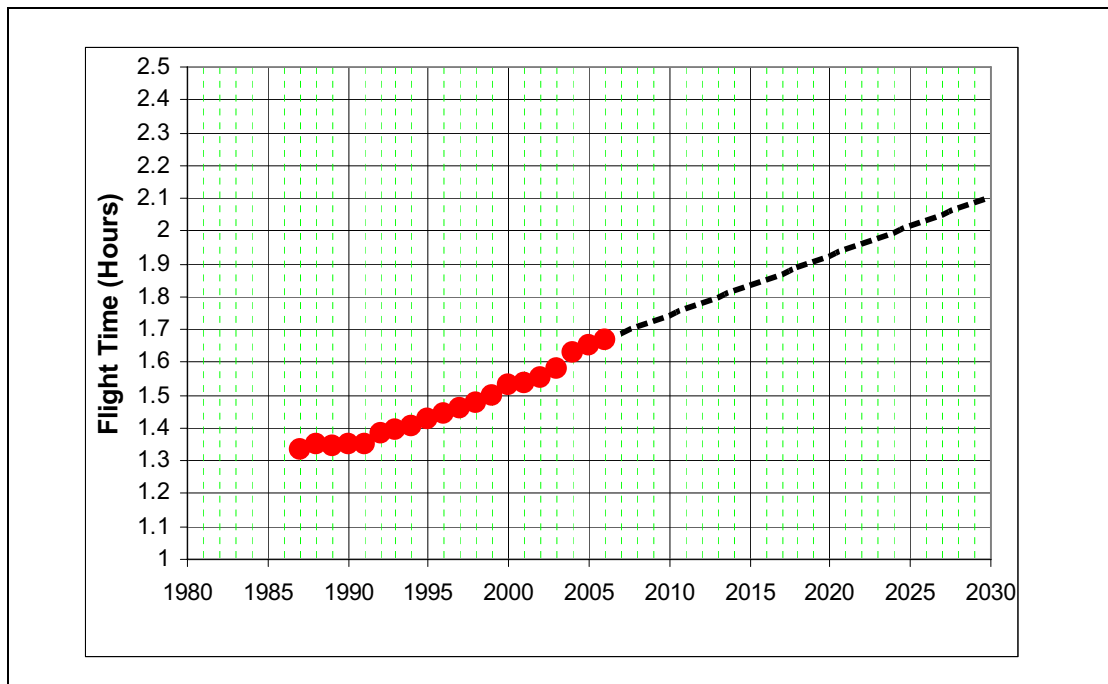


Figure 39 Growth in Average Flight Time of Western-World Fleet since 1987

The average length of flights is also increasing for UK aircraft, the length of which tend to be higher than the world fleet average. Figure 40 shows the average flight time for UK registered aircraft on a year-by-year basis from 1987 to 2006, together with an extrapolation through to 2030.

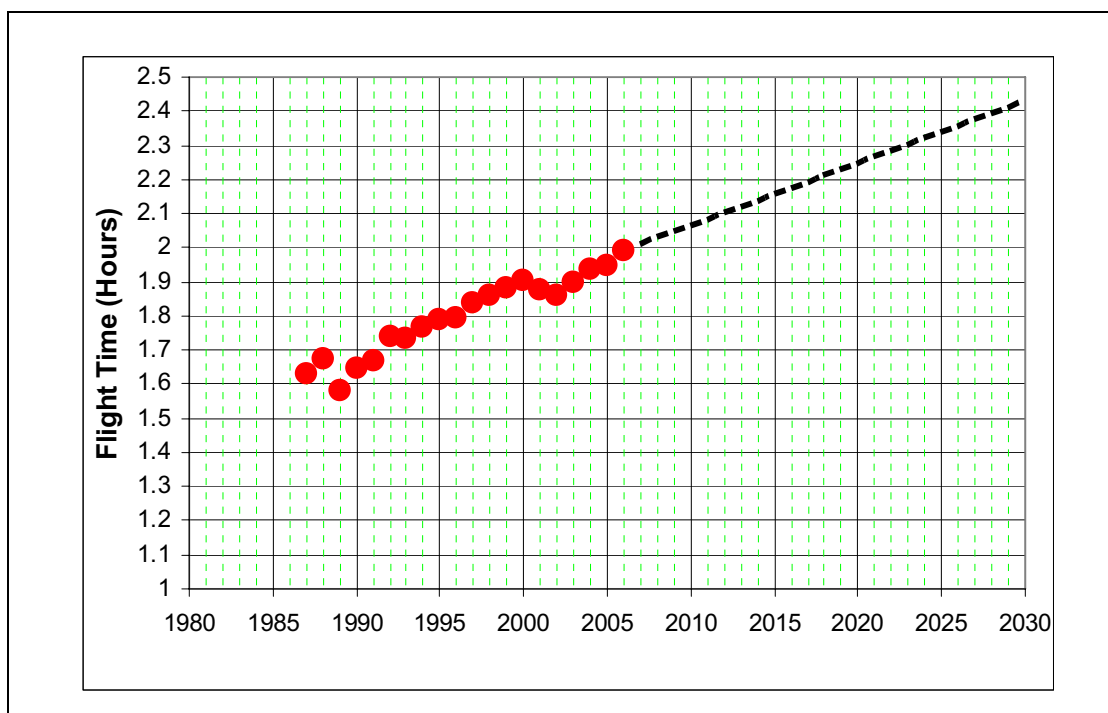


Figure 40 Growth in Average Flight Time of UK Fleet since 1987

The increasing average length of flights is an important factor in the consideration of future threats. Longer flights are likely to result in more extensive galley equipment with the potential to increase the frequency of in-flight fire/smoke occurrences – based on the study of MORs described in Section 5.1 of this report approximately one third of in-flight fire/smoke occurrences were associated with the galley.

Longer flights are also likely to increase the availability of In-Flight Entertainment systems and the use of Portable Electronic Devices (laptops, etc.) and associated in-seat power supply installations. The in-flight fire threat that might be presented by this is discussed in Sections 5.5.3.1 and 5.5.3.2 of this report.

5.5.3 **Electrical equipment within the cabin**

It is likely that electrical equipment in the cabin, both in terms of installed systems and Portable Electronic Devices carried on-board by passengers will increase markedly over future years.

5.5.3.1 **In-Flight Entertainment (IFE) system**

The frequency of In-flight entertainment systems (IFE) fire occurrences ranked highly in the higher severity fire category (see Section 5.1). The findings in the accident report (Reference 8) issued by the Canadian TSB following their investigation into the accident to an MD-11 on the 2 September 1998 contained the following:

“A segment of in-flight entertainment network (IFEN) power supply unit cable (1-3791) exhibited a region of resolidified copper on one wire that was caused by an arcing event. This resolidified copper was determined to be located near manufacturing station 383, in the area where the fire most likely originated. This arc was likely associated with the fire initiation event; however, it could not be determined whether this arced wire was the lead event.”

The potential threat posed by these systems is likely to increase in frequency over future years as flight times and the number of passengers on aircraft increase with a resultant increase in the number of seats configured with IFE systems. The following extract from a Press Release issued by Thales on 17 July 2006 (Reference 9) illustrates the magnitude of the expected growth rate in in-flight entertainment systems:

“The world market for inflight entertainment is valued at 0.8 billion euros, with an average annual growth rate of 9% projected for the next 5 years.”

Not only is it possible that more aircraft seats will be configured with IFE systems, each seat is likely to have more extensive facilities available, with a consequential increase in the number of electrical components and their associated wiring. The range of facilities likely to be offered to passengers includes more extensive use of:

- display units (with screen sizes as large as 22 inches),
- built in telephone handsets,
- in-seat power supply installations for charging of laptops and other PEDs

Whilst solid-state technology and modular systems are likely to result in higher levels of system reliability, these may be offset by the wider use of IFE systems.

5.5.3.2 Portable Electronic Devices (PEDs)

For the most part, Portable Electronic Devices (PEDs) are considered not to pose a major in-flight fire threat. The risk of fires from these devices primarily emanates from the Lithium Ion batteries that are used as their power supply. One occurrence related to an on-board fire that originated from a Portable Electronic Device and may have been associated with the battery was identified and details are contained in Appendix 3. The occurrence took place in December 2006 and was associated with a "Personal Air Purifier". Whilst no further in-flight occurrences have been identified there have been several occurrences of laptops and mobile phones (cell phones) catching fire not on-board aircraft.

The US Department of Transportation introduced:

- A ban, in December 2004, on the bulk transport of primary (non-rechargeable) lithium batteries on board passenger aircraft, and
- Restrictions in January 2008 on the number of rechargeable lithium batteries contained in carry-on baggage. The new rules are intended to reduce the risk of fires that may be caused by lithium batteries.

Although the risk of in-flight fires resulting from lithium batteries, contained in Portable Electronic Devices, can be considered as relatively small, it might be expected that the number of PEDs carried on-board aircraft is likely to increase in future with a consequential increase in the probability of their causing in-flight fires. Furthermore, testing carried out by the FAA Technical Center in Atlantic City suggests that the way in which laptop battery fires should be tackled is not obvious. The UK CAA has issued FODCOM 12/2008 which contains guidance and a checklist on dealing with cabin fires caused by lithium batteries in portable electronic devices.

Battery technology is developing rapidly and future PEDs may be powered by sources other than lithium batteries. One such possibility is the development of fuel cells. The fuels likely to be used may include diluted methanol, hydrogen and sodium hydrate. It could be that these cells present less of a fire risk than lithium batteries. However, unless the risk from PEDs are shown to be negligible, consideration will need to be given as to whether specific theoretical and practical training of cabin crew to combat these potential in-flight fire risks, is required.

5.5.4 Use of magnesium in airplane cabins

Magnesium alloys have been suggested as a substitute for aluminium alloys in seat structure, as well as other applications, due to the potential for weight savings. The concern with the use of magnesium alloys in this case is its flammability.

The current regulations do not address the potential for a flammable metal to be used in large quantities in the cabin. Therefore, airworthiness authorities have to ensure that the level of safety is not reduced. Although different magnesium alloys have varying susceptibility to ignition, once ignited, magnesium is very challenging to cope with using fire extinguishers currently available on aircraft.

The use of magnesium is currently the subject of a task group of the International Aircraft Materials Fire Test Working Group. Additional research in this area would be required addressing both the post crash and in-flight fire scenarios.

5.6 **Conclusions – Identification of Cabin Fire Threats**

UK in-flight fire/smoke occurrences

- 1 No significant trend in the annual frequency of in-flight fire occurrences could be identified over the period 2002-2006 for the UK fleet.
- 2 The majority of the in-flight fire/smoke events relevant to this study involved electrical equipment/appliances, electrical components, and electrical wiring.
- 3 Based on the MORs analysed, the five most frequent in-flight fire/smoke threats relevant to this study were:
 - i) Galley – Oven fires
 - ii) Flight deck fires
 - iii) In-flight Entertainment System fires
 - iv) Other galley equipment and appliances (coffee maker, etc) fires
 - v) Cabin – lighting-related fires

Comparison between UK and US in-flight fire/smoke occurrences

- 4 The US Service Difficulty Reporting System is intended primarily to address failures, malfunctions, and defects in systems, equipment and components and therefore is not a comprehensive data source for in-flight fire occurrences likely to be experienced by cabin crew. For the purposes of this study, the MOR system was considered a more appropriate data source.

Cabin crew problems reported in UK in-flight fire/smoke occurrences

- 5 87% of the in-flight fire/smoke related MORs analysed in this study did not mention any difficulties encountered by cabin crew in dealing with the fire/smoke. This should be considered as a baseline figure since problems might have occurred that were not reported.
- 6 Of the remaining 13%, the majority of reports were related to locating and accessing the source of the fire/smoke. The three most frequently occurring problems constituting over 90% of reports related to:
 - i) Locating and accessing the source of fire/smoke
 - ii) Isolating power supply
 - iii) Communication/coordination between cabin crew and flight crew

Issues arising from accidents

- 7 Based on an analysis of accidents and in particular the recommendations made by the accident investigation authorities, the following issues were considered to present the greatest problems to cabin crew:
 - i) Locating and accessing the source of fire/smoke
 - ii) Communication/coordination between cabin crew and flight crew
 - iii) Operating fire extinguisher
 - iv) Using Protective Breathing Equipment

Future threats

- 8 Increases in the passenger capacity related to the size of aircraft could result in:
 - i) An increase in the frequency of in-flight fire occurrences
 - ii) A need for further attention to be given to crew training associated with communications and passenger management.
- 9 The increasing lengths of flights are likely to result in more extensive galley equipment, greater availability of In-Flight Entertainment systems and a rise in use of Portable Electronic Devices. This has the potential to increase the frequency of in-flight fire/smoke occurrences attributable to these sources.
- 10 Consideration may need to be given towards the need to give specific crew training to combat fires associated with PED Battery Fires.
- 11 Any threats associated with the use of fuel cells for powering PEDs will need to be evaluated to determine whether there is a need for specific crew training.

6 Identification of Issues and Related Potential Improvements to Cabin Crew Training

6.1 Issues Relating to Training Equipment

6.1.1 Adequacy and realism of fire extinguishers used in training

The incident/accident data analysis identified that cabin crew have experienced problems related to fire extinguishers when dealing with an in-flight fire. This was further borne out by the results of the online survey, where 16% of the reported problems experienced by UK respondents who had fought or witnessed an in-flight fire were related to breaking the fire extinguisher seal and discharging the fire extinguisher.

The review of current cabin crew fire training programmes found that it is likely that the current procedures used in training were not able to demonstrate to cabin crew the characteristics of Halon and its effectiveness in dealing with an in-flight fire.

It was found that the use of a Halon extinguisher charged with water to fight a fire of a small scale did not realistically provide the cabin crew with the experience of Halon discharge and the way it reacts with fire and its effectiveness in extinguishing a fire. This was confirmed by the online survey, as many respondents indicated that they did not feel that there was adequate replication in practical training of the Halon fire extinguisher integral seal, firing mechanism and extinguishing mechanism. It was concluded that a training video that specifically addresses these issues, as suggested by some respondents of the online survey, might be of benefit. It is essential that the differences between the fire extinguishers and extinguishing agent used in training and those installed in the aeroplane be emphasised during theoretical and practical fire training due to these significant differences.

It was observed during the visit to the Royal Air Force air crew fire training that the use of water-charged extinguishers to replicate Halon extinguishers was compensated for by continuously reinforcing Halon's characteristics and application techniques throughout theoretical and practical training. In the Royal Navy crew fire training, those extinguishers not used by the trainees were demonstrated by the instructors to give trainees an appreciation of how the agents/extinguishers work. As this is not possible for Halon, the conclusion, as found during the review of current cabin crew fire training programmes (see Section 2), was that a video might be an effective alternative to demonstrate the use of a Halon extinguisher.

6.1.2 Adequacy of Protective Breathing Equipment used in training

The incident/accident data analysis identified the use of PBE as presenting one of the problems to cabin crews when dealing with an in-flight fire. This was further borne out by the results of the online survey, where 15% of the reported problems experienced by UK respondents who had fought or witnessed an in-flight fire were related to removing the PBE from its packaging and using the PBE.

The review of current cabin crew fire training programmes also found that some operators/training organisations had been using PBE training units that were in a poor condition (e.g. with loose or missing neck seal). It was also found that, although unpacking and preparing the PBE is not as straightforward as indicated in the PBE manufacturer's video, this process was never included in the practical training. These issues were confirmed by the results from the online survey, as the comments indicated that respondents were primarily concerned about the operability of PBE training units (i.e. that it is not an operational unit with oxygen), the condition of the training units, and the absence of training in removing the PBE unit from the packaging.

Other respondents suggested firefighting training should take place while using the appropriate protective equipment such as fire gloves and PBE to increase the realism of the training. Such a concept was observed in the Royal Navy and the Royal Air Force crew fire training.

In addition, the review of current cabin crew fire training programmes concluded that given the significant differences between PBE training units and operational PBE units installed on the aeroplane, it is considered essential that the differences between the units be emphasised during all fire training.

6.2 **Issues Relating to In-flight Fire Procedures**

6.2.1 **The 'Firefighter – Assistant Firefighter (Coordinator) – Communicator' firefighting procedure**

Comments from respondents of the online survey demonstrated their concerns with the prescriptive nature of the 'Firefighter – Assistant Firefighter (Coordinator) – Communicator' firefighting procedure and its training, in that it might dissuade cabin crew from using their common sense and judgement, which could be detrimental considering the unpredictable nature of in-flight fires. This was reinforced by other comments indicating that some cabin crew perceived the procedure as their only course of action, even when not feasible (as with the small crew complement operation).

6.2.2 **Firefighting procedures for single cabin crew operations**

It was concluded from the review of current cabin crew fire training programmes that in respect of single cabin crew operations, it was doubtful if one crew member could act as firefighter/coordinator/communicator as well as dealing with the issues of passenger management.

Responses to the online survey from crew of smaller aircraft types highlighted the need to have in-flight fire procedures that specifically catered for operations with less than three cabin crew, especially single cabin crew operation.

6.2.3 **Crew communication/coordination procedures**

Results from the online survey demonstrated that the overall attitude of UK respondents on the appropriateness of the procedures for communication and coordination between cabin crew was positive. This was also the case for the procedures for communication and coordination between flight and cabin crew.

The review of current cabin crew fire training programmes seemed to support this in that in most cases there appeared to be consistent procedures for communications between flight crew and cabin crew.

However, it was concluded from both tasks that joint practical training of cabin crew and flight crew would be of great benefit and this is further discussed in Section 6.3.9 below.

6.2.4 **Relationship between procedures taught in training and crew operating procedures**

The responses from the online survey indicated that most of the UK respondents, from both with and without in-flight fire experience groups, were positive about how the procedures taught in fire training corresponded to the procedures in the crew operating manual. However, the comments received by respondents who receive/provide training from a 'third-party' training organisation indicated that there was a need to ensure that procedures taught in training conform to the company's operating procedures and this is discussed in Section 6.4.4 below.

6.3 **Issues Relating to Adequacy and Realism of Training**

6.3.1 **Realism of fire conditions during training**

The comments from the online survey suggested that crew who had experienced fire training using fires fuelled by combustible materials and flammable liquid found it provided more learning points than training with a gas-powered fire.

It was found during the visit to the Royal Air Force that, in addition to the fire training carried out using 'firelighters' in the Fire and Smoke Training Facility, the aircrew had the opportunity to experience fighting wood and petrol fires of various intensities during the Common Core Skill training. It is considered that civil aviation cabin crew could benefit from practicing with such fires (not gas-powered).

The review of current cabin crew fire training programmes found that some operators/training organisations used gas-powered fire rigs for practical training, which was opposed by many UK respondents in the online survey due to its lack of realism. However, based on the observation made on the fire training for the Royal Navy crew, it was found that the use of a gas-powered fire rig could be enhanced by standardised, accurate simulation of fire behaviour, as discussed further below (see Section 6.4.3 below).

6.3.2 **Realism of smoke conditions during training**

The results of the online survey demonstrated that the attitude towards the realism of smoke conditions during training of UK respondents without in-flight fire experience was more positive than that of the respondents with in-flight fire experience. Based on the comments received, it appeared that respondents' judgement on the realism of smoke conditions during training were primarily based on the level of visibility, condition of the smoke training facilities and the scenarios in which smoke was used.

The review of current cabin crew fire training programmes found that the smoke intensities varied considerably amongst operators/training organisations. It was also identified that the duration that cabin crew actually used PBE in a smoke-filled environment also differed considerably.

Some respondents questioned the value of the non-firefighting related drills they had to carry out during PBE training in a smoke-filled environment. It would seem that whilst this was not a requirement of JAR-OPS 1, many operators implemented such a scenario since they believed that it was of value.

6.3.3 **Adequacy of training facilities**

The responses collected by the online survey indicated that overall UK respondents were somewhat positive about how representative their fire training facilities were of an actual aircraft cabin. However some of the comments indicated that there was a high variability in the standard of training facilities; this was confirmed by the review of current cabin crew fire training programmes.

Respondents' comments suggested that smoke training facilities tended to be more representative of an actual aircraft cabin than the facilities provided for fire training. Based on the comments, it appeared that some respondents felt that there was an advantage in carrying out their practical fire training in a cabin mock-up, rather than in a basic open-air facility. Some respondents stated that they would like to use cabin mock-ups that were more representative of their aircraft type for training in locating firefighting equipment and other elements of training such as locating the fire and passenger management. This is further discussed in Section 6.3.12 .

6.3.4 **Emphasis on the required urgency of response to in-flight fire**

The conclusions of the review of current cabin crew fire training programmes were that the ease in which most of the fires encountered in training were extinguished was likely to lead cabin crew to a false sense of security or confidence. This might detract from the *urgency* of the situation and that such threats must be dealt with immediately and aggressively. It was found that in some cases the overall management of the fire training might lead cabin crew to an incorrect assumption as to the seriousness of an actual in-flight fire situation. The comments received from the online survey also indicated the urgency of an in-flight fire situation was not adequately emphasised during training.

A respondent of the online survey suggested that practical training could include time constraints as a factor in tackling fire scenarios, in order to reinforce the need for urgent action in tackling an actual in-flight fire. In addition, the use of accident and incident data has been identified as a useful tool to reinforce theoretical training for cabin crew on urgent firefighting action and this is discussed in Section 6.3.10.

6.3.5 **Adequacy of training for fire behind panels and locating source of fire/smoke**

Results of the online survey found that the UK respondents who found the theoretical training for fires behind panels (hidden fires) adequate had also received practical training. Those who were less positive frequently cited the lack of practical training. Comments received suggested that conducting appropriate practical training on this type of fire threat could increase crew confidence, and that it would be valuable to improve cabin crew knowledge on the systems contained behind aircraft panels.

The incident/accident data analysis found that difficulty in locating and accessing the source of fire/smoke was the most frequent problem encountered by cabin crew when dealing with an in-flight fire/smoke event. This was further borne out by the results of the online survey, where 19% of the reported problems experienced by UK respondents who had fought or witnessed an in-flight fire were related to locating and accessing the source of fire.

Some of the comments received from the online survey suggested that locating the fire should be incorporated into practical training (see also Section 6.3.12); however, some training facilities were such that the number of possible fire locations is very limited and hence the location would be easily predictable.

6.3.6 **Adequacy of training for multiple, simultaneous fires**

The review of current cabin crew fire training programmes found that no operator included the issues of multiple internal fires and most operators had not given this any consideration. Most operators were of the opinion that this would be difficult to manage, especially with smaller aeroplanes with only a limited number of cabin crew

This was supported by the results of the online survey, whereby most respondents stated that no training for multiple, simultaneous fires, either theoretical or practical, had ever been carried out.

6.3.7 **Adequacy of training for any fire visible in the cabin**

Results of the online survey indicated that training for fires visible in the cabin appeared to be considered adequate for most UK respondents. However many respondents indicated that most practical training only focused on two or three typical fire types, as also found during the review of current cabin crew fire training programmes. Considering the limited amount of time allocated for practical fire training, alternating different fire scenarios in every practical Recurrent Training to broaden cabin crew firefighting skills may be a viable solution.

6.3.8 **Adequacy of training for management of passengers**

Responses from some participants of the online survey suggested that improvements needed to be made to this aspect of training. The survey also found that 7% of the problems reported by UK respondents were related to passenger management. Additionally, increases in the size of aircraft and consequently in the number of passengers carried may result in a need for further attention to be given to training for management of passengers.

6.3.9 **Adequacy of crew communication/coordination training**

The incident/accident data analysis identified communication/coordination with flight crew as presenting one of the problems to cabin crew when dealing with an in-flight fire. This was further borne out by the results of the online survey, where 10% of the reported problems experienced by UK respondents who had fought or witnessed an in-flight fire were related to communication/coordination between cabin crew and flight crew.

The conclusions from both the review of current cabin crew fire training programmes and the online survey highlighted the desirability of joint training for flight crew and cabin crew, to encompass communication and coordination procedures. Joint training could have the advantage of including many CRM elements as required by JAR-OPS 1. It would also provide the opportunity to address the issues relating to communication with flight crew while wearing PBE and in the event of an inoperative interphone system, which were identified in the online survey. The conclusions from both tasks were that joint training would improve flight and cabin crew performance *as a team* in the event of an in-flight fire.

The online survey found that problems in communication/coordination between cabin crew accounted for 24% of the problems reported by UK respondents who had fought or witnessed an in-flight fire. Some comments highlighted the desirability of incorporating more cabin crew communication/coordination aspects during practical training (see also Section 6.3.12). In addition, when considering future threats, communication was identified as an area requiring further attention, given the increases in the size of aircraft and the resultant increase in number of passengers and crew carried.

6.3.10 **Improving fire training through the use of accident and incident data**

The evaluation of current cabin crew fire training programmes concluded that there was potential for better use of accident and incident data to reinforce the need for urgent firefighting action in-flight and this was suggested as a valuable contribution to theoretical crew training. Respondents to the online survey also identified the use of accident/incident data as a powerful theoretical training tool. It was also observed during the visit to the Royal Air Force that re-enactment videos about in-flight fire accidents were used as a very effective teaching tool, with discussions about what should and should not have been done.

Some respondents to the online survey, who had not experienced in-flight fire, found it difficult to assess the adequacy of their training for an actual in-flight fire which might indicate that they were not fully informed as to the potential severity that might be experienced in an in-flight fire occurrence. It was concluded that incorporating actual accident and incident data as part of the training, preferably in a form of a video, would go some way to address this.

6.3.11 **Requirement for training for IFE fires and lithium battery fires in PED**

Many comments were received from the online survey indicating the need for more training on In-Flight Entertainment (IFE) system fires and lithium battery fires in Portable Electronic Devices (PEDs).

In addition, the analysis of likely future threats found that the increasing length of flights is likely to result in increases in IFE systems and the use of PED with the potential to increase the frequency of in-flight smoke/fire occurrences attributable to these sources. Therefore it was concluded that consideration may need to be given to providing specific crew training to combat fires associated with PED battery fires and IFE systems.

6.3.12 **Integrated Training Scenarios**

Respondents to the online survey suggested that cabin crew fire training in a cabin mock-up should be used not just for training in firefighting techniques, but also on the communication/coordination procedures and other aspects such as locating the fire, locating and removing firefighting equipment from its stowage and passenger management. Respondents also suggested training in firefighting while using the appropriate protective equipment such as fire gloves and PBE.

This was also concluded in the review of current cabin crew fire training programmes, where one operator was observed carrying out an 'integrated' training scenario. The visit to the Royal Navy revealed that their practical training integrated the use of breathing equipment in a smoke-filled environment, the removal and use of an extinguisher on a fire, and the execution of procedures in various scenarios in the mock-up, which also included communication. This practical training integrated all aspects of fire training. In addition, the practical training observed for the Royal Air Force crew also included integrated fire training scenarios.

6.3.13 **Relationship between in-flight fire experience and perception of adequacy of training**

A further point to note is that in *almost all the subjects covered in the survey*, respondents without in-flight fire experience exhibited a more positive attitude than respondents with in-flight fire experience. This might suggest that some degree of false confidence might exist in respondents without in-flight fire experience. This was supported by the findings of the review of current cabin crew fire training programmes, where it was identified that the ease in which most of the fires encountered in training were extinguished, may lead cabin crew to a false sense of security or confidence.

6.4 **Issues Relating to Standardisation**

6.4.1 **Standards for evaluation criteria**

The conclusions from the review of current cabin crew fire training programmes stated that JAR-OPS 1 provides no criteria in respect of what should be expected in terms of evaluating cabin crew proficiency in areas such as the use of fire extinguishers, PBE etc. This was reinforced by the apparent lack of standardisation used for proficiency evaluation witnessed during the visits, where it was found that in some cases the assessment of proficiency by the instructor was considered to be somewhat arbitrary.

This was further emphasised by the results of the online survey, which highlighted many comments from UK respondents who were concerned that there was no standard criteria used during training to measure cabin crew's firefighting skill, and their experience of the lenient approach shown by some instructors to trainees who had demonstrated poor performance.

6.4.2 Standards for duration and frequency of training

6.4.2.1 Duration of theoretical and practical training

As with all cabin crew training, JAR-OPS 1 requirements do not prescribe the duration of fire training. The evaluation of current cabin crew fire training programmes found that there is a variation in the duration of training, particularly in respect of Recurrent Training. Regardless of this variation, the online survey found that most UK respondents considered the time spent on theoretical training sufficient. With regard to practical training, the majority of UK respondents with in-flight fire experience felt it too short (as compared to those without experience who felt it was sufficient).

It is of note that, responses to the online survey indicated that some operators provided training with a minimal attention to individual performance due to the large class size and/or short duration.

6.4.2.2 Frequency of practical and theoretical training

Results of the online survey found that respondents with annual practical fire training generally regarded their training interval more sufficient for skill retention than a 2-year or 3-year interval. It was apparent that UK respondents perceived the maximum interval of three years for practical recurrent fire training, as stipulated by JAR-OPS, as the least sufficient interval. A respondent suggested more frequent training for newly qualified cabin crew members and then a longer interval after more experience is gained. Further investigation may be required to investigate the feasibility of this concept.

In comparison, the visit to the Royal Navy found that although full formal fire training for crew is only conducted every four years, drills on firefighting procedures are carried out in a full operational environment as often as once a week. In civil aviation, pre-flight briefings usually cover all aspects of safety (not just fire drills), but this would at least help in maintaining cabin crew's preparedness for in-flight fire events and hence such briefings should be encouraged more. The inclusion of a briefing on fire procedures as part of the pre-flight briefing was also raised as a suggestion for improvement by some respondents to the online survey (see Section 6.5 below).

The online survey found that some respondents were concerned with the lack (or absence) of theoretical training in Recurrent Training. It has been suggested in the review of current cabin crew fire training programmes that incorporation of theoretical training into Recurrent Training and Conversion and Differences Training would encourage operators to have more meaningful firefighting training by combining both the theoretical and the practical training elements into one session.

6.4.3 **Standards for the conduct of practical fire/smoke training and training programmes**

The review of current cabin crew fire training programmes concluded that there were significant differences, *especially in practical training*, amongst operators, in terms of duration, frequency, training equipment used, fire scenarios and smoke training scenarios. It is likely that this was a result of the requirements of JAR-OPS 1 not being sufficiently detailed and that both operators and 'third-party' training organisations have limited guidance as to what is considered an acceptable standard.

The results of the online survey also indicated the need to standardise on fire conditions in practical training, including minimum fire intensity, fire type/source, and the standards for using gas-powered fire.

In addition, comments made via the online survey suggested that consideration also needs to be given to standards for smoke conditions (visibility) and smoke training methods/scenarios, in order to ensure that the objective of the smoke training could be achieved.

6.4.4 **Regulation of training provided by 'third-party' training organisations**

The visits to 'third-party' training organisations raised some problems with consistency between operators' procedures (i.e. as contained in their Operations Manual and Training Manual) and the training being delivered by some 'third-party' training organisations. Some respondents of the online survey stated that 'third-party' training was not always specific to the operator's drills and operating procedures. It was concluded that there needs to be a means to ensure that training provided by a 'third-party' training organisation conforms to the operator's training requirements and operating procedures.

The visit to the Royal Navy revealed a training arrangement between the Royal Navy and their 'third-party' training organisation and the involvement of Royal Navy instructors that seemed to address this problem. See also Section 6.4.5, which also discusses 'third-party' instructors.

6.4.5 **Standards for instructors**

From the visit to the Royal Navy, it was established that Royal Navy instructors (and the 'third-party' instructors they use) are of a high standard. Royal Navy instructors have completed fire training to an advanced level and work closely with the 'third-party' instructors. These 'third-party' instructors are actual fire fighters that are very familiar with the Royal Navy training requirements and firefighting procedures.

The results of the online survey indicated that there appeared to be a high degree of variability in the standard of fire training instructors (see also the comments in Section 6.4.1 on quality of instruction witnessed during visits to operators and training establishments). Since training quality depends heavily on the instructor's training skills, consideration should be given to establishing a standard for fire training instructors.

6.5 Further Suggestions for Improvement

The online survey asked respondents to propose their suggestions for improvements to fire training. Section 3.13 gives a full list of the suggestions on subjects that have not been addressed in other sections, as briefly listed below.

- **Proportions of theoretical and practical training**
 - suggested more emphasis on practical training
- **Differing firefighting skills**
 - suggested a hierarchy of crew member skills, with a proportion receiving advanced training
- **Training with larger, real fires**
 - suggested exposing trainees to larger, real fires
- **Training for locating fires**
 - suggested additional training in identifying different types of fire to facilitate location of fire
- **Training for hidden fires**
 - suggested methods of training to improve crew's knowledge of systems behind cabin panels
- **Fire drills in pre-flight briefing**
 - suggested that fire procedures should be refreshed during the pre-flight briefings
- **Cabin crew selection criteria**
 - identified possible shortcomings in cabin crew selection criteria as a factor in below-standard proficiency
- **Psychological aspects of training**
 - suggested a better understanding of the psychological needs of participants to improve their training performance
- **Forum/workshop for instructors**
 - suggested a forum for sharing of information relating to fire training
- **Other methods for cabin crew coordination**
 - suggestions on alternatives in coordinating with other cabin crew during an in-flight fire event

7 Methodology for Evaluating the Identified Potential Improvements to Cabin Crew Fire Training

Based on the findings of the study, as summarised in Section 6, the potential improvements to cabin crew fire training were identified. The identification took into account the likelihood of the potential improvements being practical for civil aviation operations and having acceptable costs as compared to their benefits. It was also important that the potential improvements were substantiated by issues identified in different elements of the study.

The potential improvements were proposed in the form of:

- Amendments to future European aviation requirements
- Development of Guidance Material
- Other recommendations (general recommendations such as carrying out further research, improvements related to aircraft/equipment design issues, etc.)

The manner in which the potential improvements were evaluated was generally based on the EASA Pre-Regulatory Impact Assessment (Pre-RIA), which addressed the following:

- The importance and the scale of the issue that the proposed improvement was intended to mitigate, including:
 - 1 Current UK/European training practice and US training practice
 - 2 Suggestions and comments from cabin crew, flight crew, and instructors
 - 3 Frequency of occurrence of the problem associated with the issue
 - 4 Relevant recommendations from accident investigation authorities
- The associated current regulatory material (i.e. JAR-OPS 1 requirements, any guidance material or Civil Aviation Publication/CAP, Flight Operations Department Communication/FODCOM, etc).
- Current foreign comparable regulatory material, primarily US Federal Aviation Administration (FAA) and Transport Canada Civil Aviation (TCCA) requirements and guidance material as follows:
 - 1 TCCA Flight Attendant Training Standard TP 12296 Issue 05, April 15, 2005 (Reference 10). This training standard outlines the minimum requirements for compliance with the regulations respecting the use of aircraft in airline operations.
 - 2 US Federal Aviation Regulation Part 121 (Operating Requirements: Domestic, Flag, and Supplemental Operations), Subpart N – Training Program, particularly Section 121.417 – Crewmember emergency training, Amdt. 121-281 (Reference 11).
 - 3 US FAA Advisory Circulars, particularly AC 120-80 on In-flight Fires (Reference 12).

- 4 FAA's Flight Standards Information Management System Volume 3 General Technical Administration, Chapter 23, Section 6 (Cabin Safety and Flight Attendant Training) (Reference 13). Chapter 23 discusses Part 121 and Part 135 flight attendant training and qualification requirements and provides direction and guidance to FAA personnel responsible for the evaluation and approval of flight attendant training curricula. The document contains both Directive Information¹ and Guidance Information².
- An evaluation of the safety, economic and environmental impacts of the proposed improvements, as follows:
- 1 Safety impacts were all considered as safety benefits that may be accrued if the proposed changes were implemented by the authorities and operators. The evaluation of safety impacts took into account the prevalence of the issue or difficulties related to the proposed potential improvement in the industry. It also took into account the likelihood that the potential improvement will mitigate the issue or difficulties, considering the proposed type of training (i.e. theoretical or practical training) and the frequency of training.
 - 2 The economic impacts consisted of primarily the costs that might be incurred to the operators associated with this implementation. The costs taken into consideration were those related to non-recurring costs (i.e. capital cost such as costs related to acquiring or modifying training simulator/cabin mock-up and procurement or manufacture of training equipment/aids) and recurring costs (i.e. costs related to increases in instructor's man hours and cabin crew non-revenue time due to the additional training time, and costs related to consumables).
 - 3 Environmental impacts such as wastes and pollutions were stated only when obvious.

1. In this FAA document, **Directive Information** will contain terms such as "shall" or "must" and means the actions are mandatory.

2. In this FAA document, **Guidance Information** is considered guiding in nature (not mandatory) and will contain terms such as "will", "should", or "may".

8 Evaluation of Identified Potential Improvements to Cabin Crew Fire Training

The following are the proposed potential improvements to cabin crew fire training evaluated in this section (not in priority order, see 9.1.1):

- 1 Standards for Fire Extinguishers Used in Training
- 2 Standards for Protective Breathing Equipment Used In Training
- 3 Standards for Fires Used in Training
- 4 Standards for Smoke Training
- 5 Standards for Fire and Smoke Training Facilities
- 6 Standards for Fire Training Instructors
- 7 Evaluation Criteria in Practical Fire and Smoke Training
- 8 Theoretical Training in Fire Prevention Measures
- 9 Theoretical Training in Communication/Coordination with Flight Crew During an In-Flight Fire/Smoke Event
- 10 Practical Training in Communication/Coordination with Flight Crew During an In-flight Fire/Smoke Event
- 11 Practical Training in Communication/Coordination with Other Cabin Crew During an In-flight Fire/Smoke Event
- 12 Theoretical Training in Detecting and Locating Source of Smoke and Fire
- 13 Practical Training in Detecting and Locating Smoke/fire
- 14 Theoretical and Practical Training for Dealing with Hidden Fires
- 15 Practical Training in Removing Firefighting Equipment from Stowage during Fire and Smoke Training
- 16 Practical Training in Removing Protective Breathing Equipment from Packaging
- 17 Theoretical and Practical Training in the Management of Passengers during In-Flight Fire/Smoke Events
- 18 Requirement for Fire Scenarios Addressed in Training
- 19 Requirement for the use of Protective Equipment during Firefighting Training
- 20 Requirement for Theoretical Training in Conversion and Differences Training and Recurrent Training
- 21 Requirement for the Regulation of Training Provided by 'Third-Party' Training Organisations
- 22 Guidelines for Training Methods in Performing Firefighting Procedures
- 23 Guidelines for Implementing Integrated Fire Training Scenarios in a Cabin Environment
- 24 Guidelines for Training Methods in Emphasising the Required Urgency of Response to In-Flight Fires

8.1 Standards for Fire Extinguishers Used in Training

8.1.1 Description of Issue

The study found that the extinguishers and the extinguishing agent currently used in training generally did not adequately represent the fire extinguishers installed on board the aeroplane. This inadequate replication might have contributed to the difficulties encountered by cabin crew when operating actual fire extinguishers during in-flight fire events. This would suggest a need for the development of a standard for fire extinguishers and extinguishing agents used in training to ensure that the training objective can be achieved.

8.1.2 Scale of the Issue

Standard for fire extinguishers used in training

JAR-OPS 1 requirements state that the fire extinguishers used in practical training should be representative of those carried in the aeroplanes to be operated by the cabin crew. Whilst during practical training some operators used Halon fire extinguishers of the type carried on board their aeroplanes, charged with water, others used water fire extinguishers, many of which were not representative in size and/or weight to those carried on-board aeroplanes.

When asked about the similarity of equipment used in training with the equipment on board the aircraft, many respondents to the online survey indicated that they did not believe that there was adequate replication for the Halon fire extinguisher integral seal and operating mechanism in practical training (see Section 3.5.3):

"Never get to test a BCF in real conditions - on a flight several BCFs were thought inoperable due to crew not being able to break the seal on the BCF, therefore wasting valuable seconds and risking a potential disaster." (Cabin Crew)

"In my view, cabin crew underestimate how difficult/hard it is to break the copper wire inside a BCF which releases the red disc. The realisation and experience only comes through in practical. The manual can not prepare a crew for that eventuality." (Cabin Crew)

"Crew have commented on their difficulties when using a BCF - they are unaware of the strength needed to break the seals and the power and range when dispersed and a "test squirt" sometimes jams the trigger mechanism open - most crew were unaware of the procedure to un-jam (pull back out) the trigger." (Cabin Crew)

The online survey found 16% of the reported problems experienced by UK respondents who had experience with in-flight fire were related to operating fire extinguishers (see Section 3.7). Approximately 55% of these problems were related to the difficulty in breaking the fire extinguisher seal.

"Was not using the equipment personally but crew member struggled to break seal on the BCF..."

"...On both occasions extinguisher failed to operate due to the seal inside being difficult to break crew thought extinguisher was broken..."

In an in-flight fire event in an overhead bin on board a UK registered wide-bodied aeroplane in December 1998, the cabin crew member who initially responded to the fire threat failed to exert enough pressure on the extinguisher's operating handle to break the integral seal and initiate discharge of the Halon. This action was eventually achieved by a passenger (see Section 2.2.3).

One supplier manufactures brass seals that can be inserted into a training Halon extinguisher to replicate the forces needed to break the seal and to initiate Halon discharge. One of the operators visited did in fact use these seals on an individual basis for both cabin crew and flight crew during Conversion and Differences Training, as well as Recurrent Training. The use of such seals can confirm a cabin crew's proficiency in operating the fire extinguisher and provides them with first-hand experience of the pressure needed to break the seal and achieve Halon discharge. It should be noted that not all Halon extinguishers have this difficulty of breaking the seal, but the type of Halon extinguisher discussed above is carried on a substantial number of UK registered aeroplanes.

In addition, given the significant differences that exist between fire extinguisher training and the actual practice of using Halon fire extinguishers installed in the aeroplane, it is essential that these differences be emphasised during theoretical and practical fire training (see Section 2.2.1).

Standard for extinguishing agent used in training

The review of current cabin crew fire training programmes found that it was likely that the current training practice is not adequate in demonstrating the characteristics of Halon and its effectiveness in dealing with an in-flight fire. It was found that the use of a Halon extinguisher charged with water to fight a small scale fire did not, in any realistic way, provide the cabin crew with the experience of Halon discharge, the way it reacts with fire and its effectiveness in extinguishing a fire (see Section 2.2).

It was concluded that, whenever an alternative agent, such as water, is used in training, it is very important that the differences between the agent used in training and the actual agent contained in the fire extinguishers installed in the aeroplane be addressed. When the restrictions on the use of Halon were first implemented in the UK, the Civil Aviation Authority considered it important that cabin crew were provided with additional information on the application of Halon extinguishers in different fire scenarios. The CAA provided technical support to a video producer and subsequently agreed an in-flight fire training video that identified some of the training shortfalls of not being able to use Halon during fire training. The use of a video to demonstrate the actual extinguishing agent is supported by some of the comments received from the online survey (see Section 3.5.3):

"I think real scenarios should be used and real BCF used to put out a fire so that crew know what to expect in reality e.g. that a paper fire can result in burning embers being scattered and how quickly a fire in a confined space can be extinguished by a relatively small amount of BCF. I realize that there are environmental concerns with the use of BCF for demonstration purposes though. Film demo may be a way around this." (Cabin Crew)

It was observed during the visit to the Royal Air Force air crew fire training that the use of water-charged extinguishers to replicate Halon extinguishers was compensated for by the instructor continuously reinforcing Halon's characteristics and application techniques throughout the theoretical and practical training (see Section 4.2.5). In the Royal Navy crew fire training, those extinguishers not used by the trainees were demonstrated by the instructors to give trainees an appreciation of how the agents/extinguishers work (see Section 4.1.5). Again, since this is not possible for agents with restrictive use (such as Halon), a video might be an effective alternative to demonstrate the use of an actual extinguisher and extinguishing agent.

The extinguishing agent used by the US training organisation evaluated in this study is dry powder. According to the training organisation, dry powder was chosen as the extinguishing agent in their training because it had the advantage of providing a visual reference and had less impact on their training devices. Further investigation may need to be conducted to ascertain other advantages (or disadvantages) of using dry powder, as opposed to water, to replicate Halon in fire training (see Section 2.2).

8.1.3 Associated Current Regulatory Material

Standard for fire extinguisher and extinguishing agent used in training

JAR-OPS 1 requirements do not specify what is considered to be a “representative” fire extinguisher or what is acceptable as “an alternative extinguishing agent” to be used in fire and smoke training.

CONVERSION AND DIFFERENCES TRAINING – Appendix 1 to JAR-OPS 1.1010

(b) Fire and smoke training. An operator shall ensure that:

(1) Each cabin crew member is given realistic and practical training in the use of all fire fighting equipment including protective clothing **representative** of that carried in the aeroplane. This training must include:

*(i) Each cabin crew member extinguishing a fire characteristic of an aeroplane interior except that, in the case of Halon extinguishers, **an alternative extinguishing agent** may be used;*

(Similar to RECURRENT TRAINING – Appendix 1 to JAR-OPS 1.1015 (c)(3)(i))

CAP 768 Chapter 29 Paragraph 7.2 states:

“Conversion and Differences Training and three-yearly Recurrent Training may be achieved by using an extinguisher fully representative of the Halon extinguisher in respect **of size, weight and operating characteristics** but charged with an alternative agent to normal operating pressures (subject to approval of the extinguisher manufacturer). **Operators should show a film, approved by the CAA, which demonstrates methods of extinguishing fires and characteristics of aircraft interior fires. The film includes the use of Halon extinguishers on fires related to typical aircraft situations.**”

Additionally, CAP 768, Chapter 29, Paragraph 7.4 (d) states:

*... “If use of the representative aircraft fire extinguisher is not achievable, a substitute extinguisher should be as similar as possible to that carried on board the aircraft. When considering a substitute extinguisher for this practical exercise, operator should be aware **that any major discrepancies in basic characteristics e.g. size, weight, operating mechanism, etc., are not acceptable.**”*

8.1.4 Foreign Comparable Regulatory Material

TCCA Flight Attendant Training Standard (Reference 10) for Initial (7.6.3 b) and Annual (7.8.3 b) Fire Fighting Training requires that firefighting equipment used in training shall be identical in weight, dimensions, controls, types and operation. However, these requirements do not specify the requirement for the agent in detail:

Fire fighting equipment and the brackets used for restraint shall be **identical** to those installed in the aircraft with respect to **weight, dimensions, controls, types and operations**. Fire extinguishers used for live fire fighting shall be charged with the **appropriate agent or with an environmentally friendly agent**.

The requirement for crew member emergency training in US Federal Aviation Regulation Section 121.417 (Reference 11) includes a definition for *Approved fire extinguisher*, which is “a training device that has been approved by the Administrator for use in meeting the training requirements of Sec. 121.417(c)”.

The US FAA General Technical Administration Volume 3 Chapter 23 Section 6 (Reference 13) Paragraph 3-1858 C 2) states that:

Principal operations inspectors (POI) may approve the use of fire extinguishers that closely simulate the ones installed on the airplane.

8.1.5 **Possible Change to Current Regulatory Material**

Training Affected

Conversion and Differences Training

Recurrent Training (3-yearly)

Proposed Change to Future European Aviation Requirements

It is proposed that consideration be given by EASA to amending Conversion and Difference Training and Recurrent Training to add the following:

- 1 *An operator shall ensure that the fire extinguisher(s) used in the practical training of cabin crew are representative of those carried on board the aeroplane in respect of size, weight, colour, operating mechanism and the forces required to initiate extinguishment discharge.*
- 2 *An operator shall ensure that each cabin crew member has a full understanding of the extinguishing mechanism, operating method, and application method of the extinguishing agent used in operational extinguishers carried on board the aeroplane. This may be achieved by:*
 - *Using the actual extinguishing agent, if possible (non-Halon); or*
 - *Using an environmentally friendly alternative extinguishing agent having similar characteristics to those of the agents used on board the aeroplane. When this alternative agent is used, additional instructions that emphasise the difference and demonstration or video playback of the actual agent is required.*

Proposed Guidance Material

It is proposed that consideration be given by UK CAA (and/or EASA) to providing guidance material based on the contents of CAP 768 Chapter 29 Paragraph 7 and the subjects addressed in the proposed change to future European aviation requirements above.

8.1.6 **Safety, economic and Environmental impacts**

Safety Impact

It was assessed that inadequate replication of the main characteristics of the actual fire extinguishers and extinguishing agent carried on board the operator's aeroplanes was prevalent across the industry, and this might have contributed to the difficulties experienced by cabin crew during incidents. It is likely that the improved standards of fire extinguishers used in training associated with the proposed change would have a substantial effect in mitigating the difficulty in operating actual fire extinguishers during an in-flight fire event.

Economic Impact

The implementation of the proposed change is likely to incur some additional costs to the operators due to:

- Incremental costs related to the required procurement/manufacture of training equipment, for operators/training organisations that have not used representative fire extinguishers in their practical fire training.

- Incremental costs related to the required consumables, in this case the use of brass seals to replicate the forces required to break the integral seals in actual fire extinguishers.
- Incremental costs related to recharging of training fire extinguishers with actual agents (if the operator's aeroplanes carry fire extinguishers with Halon replacement agent), or other agents having similar characteristics to the actual agent.
- Amendment and change to Training Manuals and Operations Manual.

There would be costs incurred to the authorities in developing the guidance material and costs related to the regulatory process in amending future European aviation requirements.

Environmental Impact

Training with actual agents (for fire extinguishers with Halon replacement agents) will not have any significant adverse environmental impact since any approved Halon replacement agents should meet the requirements for ozone depletion potential (ODP), global warming potential (GWP), and atmospheric lifetime.

8.1.7 **Summary**

Findings from the review of current cabin crew fire training programmes, the online survey, the review of non-civil aviation training programmes, and the accident/incident data analysis suggested that standards for fire extinguishers and extinguishing agents used in training need to be provided. It was also found that standards of fire extinguishers used in training are addressed in US FAA and Transport Canada Civil Aviation regulatory material. Whilst the economic impacts need to be taken into consideration, addressing this subject in future European aviation requirements will ensure that an improved safety level can be achieved throughout the industry. Detailed guidance material will support the proposed requirements and ensure that operators adopt the best practice in carrying out practical training in using fire extinguishers.

Additional Information

It is important to note that the ICAO has been recommended by the United Nations Environment Programme's (UNEP) Ozone Secretariat (Reference 14) to consider a mandate to be effective in the 2011 time frame for the replacement of Halon in:

- 1 Lavatories for new production aircraft; and
- 2 In lavatories, hand-held extinguishers, engines and APUs for aircraft for which a new application for type certification has been submitted.

UNEP also recommended ICAO to consider a mandate to be effective in the 2014 timeframe for the replacement of Halon in hand-held extinguishers for new production aircraft. Given that a considerable amount of time is usually required for any rulemaking activity, **the amendment to the requirements related to this subject should take into consideration the use of Halon replacement agents.**

The 2006 Report of the Halons Technical Options Committee (Reference 15) stated:

"The finalized handheld MPS was published in August 2002. As of 2003, three Halon alternatives, HFC-227ea, HFC-236fa and HCFC Blend B, were commercially available and had successfully completed all of the required handheld UL and MPS tests. These units have different volume and weight characteristics compared to existing Halon 1211 extinguishers and the development of new brackets and supports may be required for new airframes and/or retrofit. Qualification and installation certification by airframe

manufacturers and regional authorities is needed prior to airline use, however to date this has not happened despite the extinguishers being available since 2003. **The change to an alternative suppression agent will also require that a new training programme be developed for flight crew/attendants.** Currently, no alternative agents have replaced Halon 1211 in handheld fire extinguishers in passenger compartments on current aircraft models or new airframe designs.”

8.2 Standards for Protective Breathing Equipment Used In Training

8.2.1 Description of Issue

The study found that consideration should be given to amending future European aviation requirements to specify the standard for PBE units used in training.

8.2.2 Scale of the Issue

The review of cabin crew fire training programmes found that PBE training was usually conducted using training units with neck seals that in most cases did not replicate the tightness of the seals to be encountered on a operational unit. In one case the condition of some neck seals were in such a bad condition as so to be almost non-existent (see Section 2.2.4). These training units were disproportionately easy to don due to the poor state of the neck seals, and hence might not be considered representative of the actual units on board the aeroplanes. Poor condition of PBE training units was highlighted in some of the comments received from the online survey (see Section 3.5.3)

“The equipment used in fire training which I do not think is similar to the equipment on board is the PBE. In training we do not take it out of its plastic box and protective wrapping. They are also very 'battered', neck seal loose or missing. I would like to experience a really live PBE, so I would feel more confident should the need arise on board....” (Cabin Crew)

“As the smoke isn't harmful many crew don't realise the need to use a smokehood. The smokehoods used allow crew to breath in outside air and don't give a sufficient realisation of using a real smokehood. On many occasions the seals on the hoods are loose and unrepresentative.” (Instructor)

Additionally many significant characteristics of ‘operational’ PBE could not be replicated with training units, such as ‘quick-start’ operation, manual start, heat generation and supply of breathable oxygen. These are features that should provide the cabin crew member with a greater sense of confidence in the effectiveness of PBE (see Section 2.2.4).

In one case, the crew used PBE in practical training which was not carried on board the operator’s aeroplane.

In at least one case, the differences between the operation of the PBE used in training and the actual equipment carried on the operator’s aeroplanes was emphasised throughout the practical training (see Section 2.2.4). This emphasis during training is essential, given the significant differences between the PBE and the training equipment, and consideration should be given to including it in all fire training.

Comments made in the online survey indicated that due to the absence of the oxygen supply, wearing the non-operational PBE (training unit) often presented problems for cabin crew and might affect their general attitude towards wearing actual PBE during an actual fire/smoke event.

“In an ideal world I would like to be able to put out a real fire using real, working equipment. Because the smokehood is just a dummy model, it is very difficult to breathe whilst wearing it as I find myself having to suck the air in from outside.” (Cabin Crew)

"I realise there are economic constraints but I feel that all crew should experience a working smokehood at least once in training. "Dummy" smokehoods feel like it is harder to breathe, I'm pretty sure this is not the case with the real thing!" (Cabin Crew)

15% of the problems encountered when dealing with in-flight fire/smoke reported in the survey by UK respondents were related to using Protective Breathing Equipment (see Section 3.7). Based on MOR analysis, problems related to using PBE accounted for 2% of the problems cited in the report (see Section 5.3). In this particular case, the cabin crew had incorrectly operated the PBE and damaged the operating lever:

...the user may have inadvertently damaged the operating lever as a result of a perceived difficulty experienced during donning of the hood. This appears to be an issue of the design and method of use of the equipment and discussions with the cabin crew concluded that the operational handling of the smoke hood was carried out incorrectly, which damaged the operating lever prior to donning the mask. A notice has been issued to Cabin staff emphasising the correct handling of the smoke hood and the subject has been introduced into cabin crew training sessions.

This indicates the need to ensure that PBE training units should also replicate the operating mechanism, in type and forces/methods needed to operate the components involved.

8.2.3 **Associated Current Regulatory Material**

The JAR-OPS 1 requirements do not specify the attributes required for the training PBE to be considered "representative of that carried in the aeroplane".

8.2.4 **Foreign Comparable Regulatory Material**

The requirement for crew member emergency training in US Federal Aviation Regulation Section 121.417 (Reference 11) includes a definition for an *Approved PBE simulation device, which is* "a training device that has been approved by the Administrator for use in meeting the training requirements of Sec. 121.417(c)."

The US FAA General Technical Administration Volume 3 Chapter 23 Section 6 (Reference 13) Paragraph 3-1858 D states that:

PBE training should include:

Accurate simulation of PBE installed on the aircraft. POIs [Principal Operations Inspectors] and/or CSIs [Cabin Safety Inspectors] if applicable should ensure that PBE used in training properly simulates the weight, method of donning, method of activation, and appearance of the actual PBE.

8.2.5 **Possible Change to Current Regulatory Material**

Training Affected

Conversion and Differences Training

Recurrent Training

Proposed Guidance Material

It is proposed that consideration be given by UK CAA (and/or EASA) to providing guidance material to address standards for PBE used in training, with emphasis that the PBE used in training must properly simulate the weight, method of donning, method of activation, and appearance of the actual PBE, including the state of PBE neck seals. Any differences between the actual and training units should be emphasised during training.

8.2.6 **Safety, economic and Environmental Impacts**

Safety Impact

Inaccurate replication of the actual PBE units in training might detract from the objectives of PBE training, or even cause difficulties when operating the actual PBE units. As the findings of the study suggested, the issue associated with PBE training units was prevalent in the training provided by the majority of operators and training organisations. Therefore, it is likely that accurate representation of PBE training units would significantly improve skills in using PBE for the majority of cabin crew. The skill of using PBE promptly and correctly would not only be valuable in an in-flight fire event, but also smoke events and evacuations.

Guidance material alone would not ensure that these safety benefits can be obtained; it has to be demonstrated by operator and 'third-party' compliance together with inspection and oversight by the authorities.

Economic Impact

The implementation of the proposed change is likely to incur some additional costs to the operators, which are related to replacing the PBE training units or associated components as and when required. For a large operator, this may occur several times a year.

There would be costs incurred to the authorities in developing the guidance material.

Environmental Impact

None identified.

8.2.7 **Summary**

As suggested by findings from the review of current cabin crew fire training programmes, the online survey, and the accident/incident data analysis, consideration needs to be given to specifying the standard for PBE used in training. It was also found that the US FAA regulatory material requires PBE training units to be approved for the PBE training specified. Detailed guidance material specifying the standard for PBE used in training will support the requirements and ensure that the objectives of PBE training are achieved accordingly.

8.3 **Standards for Fires Used in Training**

8.3.1 **Description of Issue**

The review of cabin crew fire training programmes identified that the type and size of the fire used in practical fire training varied considerably amongst operators and training organisations visited. In almost all of the operators and training organisations visited, the fires presented little or no challenge to cabin crew in "extinguishing" the fire. It is possible that this might lead cabin crew to a false sense of security or confidence. The study also highlighted the concern with using gas-powered fires whereby in some cases the instructor turns off the supply of gas rather than the cabin crew member actually extinguishing the fire. This is particularly a concern when the cabin crew have no prior experience in dealing with actual (not gas powered) fires.

8.3.2 **Scale of the Issue**

Standard for fire properties

The review of current cabin crew fire training programmes found that the procedures and the realism of fires used for the training of cabin crew in the use of extinguishers varied significantly amongst operators and training organisations. It was found that the magnitude of fires varied from a very large galley fire to a very small fire in an

oven, using different fire sources from flammable liquid fire, gas-powered fire, to firelighters (see Section 2.2.2). These different magnitudes and type/source of fires also resulted in different levels of difficulty in terms of extinguishing the fires. This is in line with the polarity of attitude/perception observed in the distribution of responses to the statement "*The fire conditions experienced during training are realistic*" in the online survey (see Section 3.5.1), from both UK respondent groups (with and without in-flight fire experience). The study concluded that the high variability of fire properties in practical fire training might in part be due to a lack of specific training requirements or standards.

The results of the online survey also indicated the need to improve the fire conditions in practical training in some operators/training organisations (see Section 3.5.1).

"Practical fire training is incredibly unrealistic. Basically a gas barbecue simulating flames and poor simulation of BCF extinguishers don't help. Fire training needs to be putting out REAL fires with REAL extinguishers in REAL confined spaces in REAL cabin environments..." (Flight Crew)

"The practical firefighting involves merely one squirt of water from the fire extinguisher onto a fire that is immediately extinguished by the instructor turning off the gas supply. The training is perfunctory and unrealistic; it seems designed merely to tick the appropriate boxes to maintain currency." (Flight Crew)

The review of current cabin crew fire training programmes identified that the ease in which most of the fires encountered in training were extinguished, might lead cabin crew to a false sense of security or confidence. This may detract from the urgency of the situation and that all in-flight fire and smoke situations must be dealt with immediately and aggressively. In most cases, re-ignition of the fire did not occur, which again demonstrated the ease with which the fires were dealt with (see Section 2.2.2). Comments received from the online survey on this subject reflect this:

*"The scenarios and equipment may be the same, but it doesn't mean that the training is GOOD ENOUGH for cabin crew to put out any fire apart from minor fires like oven and toilet bin and **ONLY if the fire is small!!!**"* (Cabin Crew)

"... Health and safety regulations meant fire situation wasn't that realistic (fear of being sued... in case of injury). I feel in a real situation it would be much scarier for crew and I think we should be prepared for that during the practical training by being shown it, rather than to be told to imagine. I think crew would probably panic less in a real fire situation if they understood the importance of acting quickly and following drills..." (Cabin Crew)

The review of current cabin crew fire training programmes also found that there might be some benefit in giving cabin crew the experience of being exposed to a large fire, since each of the cabin crew who were exposed to large fires were of the opinion that they gained confidence in their firefighting skill (see Section 2.2.2).

There should be guidance setting out the objectives of exercises in practical fire training, and the criteria for the fire used in that training, in order to achieve these objectives. These criteria may include, but not be limited to, fire source/type, magnitude, and duration relevant to the objectives of the exercise.

8.3.3 The use of gas-powered fire training devices

The review of current cabin crew fire training programmes found that in several cases where gas-powered fire rigs were utilised, the fire was terminated by the instructors when they determined that the cabin crew member had demonstrated their proficiency in extinguishing the fire. When the cabin crew carry out this type of training for compliance with Appendix 1 to JAR-OPS 1.1010 (b)(1)(i) and JAR-OPS 1.1015 (c)(3)(i) requirements (see Section 8.3.3), it is questionable whether this current practice actually meets the requirements (i.e. whether the trainees actually “extinguish” the fire) – although it may be argued that there is no further explanation for the term “extinguishing” in JAR-OPS 1. Additionally, it was identified that in some cases, the assessment of proficiency (i.e. extinguishment of fire) by the instructor was considered somewhat arbitrary (see Section 2.2.2).

It should be established by the authorities whether the use of gas-powered fires meets the JAR-OPS 1 requirements, specifically in cases where the fire is terminated by the instructor without a particular standard. This is particularly relevant when cabin crew have no prior experience of extinguishing actual (not gas-powered) fires. In such a case, having a standard for the use of gas-powered fire is important to ensure accurate simulation of real fire behaviour, as observed in the practical fire training for Royal Navy crew (see Section 4.1.5). This standard should also ensure that assessment of proficiency is carried out by the instructors consistently.

A comment made by a respondent of the online survey found that applying standards for fire extinguishment was the current practice in a non-UK training organisation (see Section 3.5.1):

“Many years ago I was shown and was most impressed by the very realistic and all moving cabin simulator in Dubai. This also had pretty good ‘fires’ and a good way of checking how they were tackled so that they would only ‘go out’ when the extinguisher was used and directed correctly. Is this type common now or still a rare example of a good simulator? Without such equipment training will be well short of ideal.” (Instructor – UK)

8.3.4 Exposure to actual (not gas-powered) fires

Although the use of actual fires fuelled by combustible materials (wood, paper, etc) or flammable/combustible liquids may result in more environmental impacts and may be subject to many Health and Safety restrictions, it can provide more training benefits than using gas-powered or other simulated fires. As mentioned in an NFPA Bulletin (see Section 8.3.4), ‘live’ fire training using actual fire provides crew members with psychological conditioning, firefighting techniques, and knowledge of extinguishing agent capabilities and limitations under actual fire situations. Whilst a gas-powered fire can be considered as an actual fire, it may not provide those training benefits to the same level as ordinary combustible or flammable liquid fires and may not behave the way that typical aircraft in-flight fires do (unless it is designed to accurately simulate them).

This issue was reflected by some of the comments received from the online survey (see Section 3.5.1):

“When I started flying in 1991 we trained on airport with real fire and smoke and it was very realistic and gave you a real idea of how dangerous a cabin fire can be and how rapidly it can spread and how restricted your vision can be. We should have more realistic conditions. The harder you train the easier it is when it happens for real...” (Cabin Crew)

"...there really is nothing quite like the experience of fighting real fires with real extinguishing agents in confined places with all the heat and smoke that goes with it to truly appreciate the seriousness of a fire..." (Flight Crew)

"When real extinguishers were used in the past on real petrol/oil fires the exercise was not always successful (the fire did not go out). This taught candidates to use the extinguishers effectively and to recognise just how little we have on board." (Flight Crew/Instructor)

It was found during the visit to the Royal Air Force that, in addition to the fire training carried out using 'firelighters' in the Fire and Smoke Training Facility, the aircrew had the opportunity to experience fighting extensive wood and petrol fires during the annual Common Core Skill training (see Section 4.2.1).

Unless the use of gas-powered fires is found to provide the same benefits as mentioned in the NFPA bulletin above, it may be worth considering using fires fuelled by combustible materials and flammable liquid of a reasonable magnitude to practice general firefighting techniques during 3-yearly Recurrent Training or during Conversion and Differences Training and using gas-powered or other simulated fires for training in the procedures in dealing with specific fires (i.e. oven fire, overhead bin fire, etc.). It may also be possible for operators/training organisations to combine this training, i.e. using actual fires of a certain specification for procedure training. This issue was reflected in the following comment (see Section 3.5.1):

*"In a previous company, fire extinguishing was practiced on a burning petrol "puddle" of about 1sqm and also on burning clothes/fabric soaked with flammable liquid, with actual airport firemen. Far more interesting and realistic than current company using an in-house "gas BBQ" mock-up type with in-house trainers. **The latter might be better to train the procedures, but doesn't help in actual fire fighting technique (fire re-ignition and spread, spreading of burning material due to extinguisher blast, ...)**" (Flight Crew)*

8.3.5 Associated Current Regulatory Material

Appendix 1 to JAR-OPS 1.1010 and 1.1015 requires each cabin crew member "extinguishing a fire characteristic of an aeroplane interior fire"; however, there is no further guidance or specifications on the subject.

CONVERSION AND DIFFERENCES TRAINING – Appendix 1 to JAR-OPS 1.1010

(b) Fire and smoke training. An operator shall ensure that:

(1) Each cabin crew member is given realistic and practical training in the use of all fire fighting equipment including protective clothing representative of that carried in the aeroplane. This training must include:

(i) Each cabin crew member **extinguishing a fire characteristic of an aeroplane interior fire** except that, in the case of Halon extinguishers, an alternative extinguishing agent may be used; and

RECURRENT TRAINING – Appendix 1 to JAR-OPS 1.1015

(c) An operator shall ensure that, at intervals not exceeding three years, Recurrent Training also includes;

(3) Each cabin crew member being given realistic and practical training in the use of all fire-fighting equipment, including protective clothing, representative of that carried in the aeroplane. This training must include:

(i) Each cabin crew member **extinguishing a fire characteristic of an aeroplane interior fire** except that, in the case of Halon extinguishers, an alternative extinguishing agent may be used; and

8.3.6 Foreign Comparable Regulatory Material

TCCA Flight Attendant Training Standard (Reference 10) requires each cabin crew member to carry out a live firefighting drill using actual fire during Initial Training and once every third Annual Fire Fighting Drill:

7.8.5 Live Fire Fighting Drill

a. Each trainee shall demonstrate the effectiveness of a fire extinguisher correctly applied to an **actual fire** while wearing a P.B.E.

7.6.8 Live Fire Fighting

a. Once every third annual training year, each cabin crew member shall demonstrate the effectiveness of a fire extinguisher correctly applied to extinguish an **actual fire** while wearing P.B.E.

There is no further guidance on the criteria of “actual fire” that should be used in the Live Fire Fighting Drill in TCCA regulatory material. However, TCCA Flight Attendant Training Standard (Reference 10) for Simulation Scenarios in Initial (7.8.2) and Annual (7.6.2) Fire Fighting Drill states:

- a. Cabin fire fighting drills may include class A, B, C ¹ fires in the following locations:
- (i) Cabin area (e.g. under seat, overhead bin, closet);
 - (ii) Galley area (e.g. garbage bin, upper electrical panel, oven);
 - (iii) Confined area (e.g. waste bin, lavatory); and
 - (iv) Hidden (e.g. behind panels).

The US Federal Aviation Regulation Section 121.417 (Reference 11) requires:

(c) Each crewmember must accomplish the following emergency training during the specified training periods, using those items of installed emergency equipment for each type of airplane in which he or she is to serve (Alternate Recurrent Training required by Sec. 121.433(c) of this part may be accomplished by approved pictorial presentation or demonstration):

(1) One-time emergency drill requirements to be accomplished during Initial Training. Each crewmember must perform—

1. According to TCCA Flight Attendant Training Standard, Class A is combustibile material fires, Class B is grease/spill fires, Class C is electrical (see Section 8.12.4)

(ii) At least one approved firefighting drill in which the crewmember **combats an actual fire** using at least one type of installed hand fire extinguisher or approved fire extinguisher that is appropriate for the type of fire to be fought. This firefighting drill is not required if the crewmember performs the PBE drill of paragraph (c)(1)(i) by combating an actual fire; and

This FAR Section also provides definitions for *Actual fire* and *Simulated fire*:

(f) For the purposes of this section the following definitions apply:

(1) **Actual fire** means an ignited combustible material, in controlled conditions, of sufficient magnitude and duration to accomplish the training objectives outlined in paragraphs (c)(1)(i) and (c)(1)(ii) of this section.

(8) **Simulated fire** means an artificial duplication of smoke or flame used to create various aircraft firefighting scenarios, such as lavatory, galley oven, and aircraft seat fires.

The US FAA General Technical Administration Volume 3 Chapter 23 Section 6 (Reference 13) Paragraph 3-1858 E and F addresses the objectives of firefighting training and the relevant use of actual and simulated fires, as follows:

E. The nature and value of combatting an actual fire.

1) Many people confuse meeting training objectives of fighting an actual fire with the psychological benefits that one can gain through experiencing an actual fire. The psychological effect of facing an actual fire cannot be achieved through simulation. The National Fire Protection Agency's (NFPA) Bulletin No. 406, Aircraft Hand Fire Extinguishers, states that live fire training provides crewmembers with psychological conditioning, firefighting techniques, and knowledge of extinguishing agent capabilities and limitations under actual fire situations. The bulletin also recommends firefighting training with an actual fire be reinforced by classroom instruction using manipulative skills training (simulation). The recommended fire simulation scenarios include:

- *Galley fires*
- *Lavatory fires*
- *Flight deck fires*
- *Closed compartment fires, and*
- *Flammable liquid fires*

2) An actual fire means an ignited combustible material, in controlled conditions of a sufficient magnitude and duration to accomplish the training objectives set forth in the rule.

3) Industry practice shows that air carriers frequently contract local or airport fire departments. In some cases, fire department personnel are present during training. Many local fire departments provide training course outlines on the use of small, hand-held fire extinguishers and they also typically provide training on the operation of hand-held fire extinguishers to employees of local businesses and organizations. Under fire department supervision, these employees are given the opportunity to extinguish an actual fire.

4) When creating actual fires, fire departments and air carriers often use, among other materials, kerosene or diesel fuel floating on water in a metal pan or drum. These fires are ignited outdoors in an open area. Some air carriers and fire departments have constructed indoor fire rooms or fire pits in which they ignite materials such as seat cushions and use exhaust fans to eliminate smoke following the fire fighting training.

F. Simulation.

- 1) A simulated fire is an artificial replication of a fire used to create the various firefighting situations that could occur on an aircraft. For example, electric lights that the instructor controls by turning them on and off to show that the crewmember has extinguished the fire correctly.

8.3.7 Possible Change to Current Regulatory Material

Training Affected

Conversion and Differences Training

Recurrent Training (3-yearly)

Proposed Change to Future European Aviation Requirements

It is proposed that consideration be given by EASA to:

- 1 Amending **Conversion and Differences Training** to add the following:

An operator shall ensure that each cabin crew member is given psychological conditioning, firefighting techniques, and knowledge of extinguishing agent capabilities and limitations under actual fire situations by providing realistic and practical training in **extinguishing an actual fire**, using firefighting equipment including protective equipment representative of that carried in the aeroplane. This firefighting drill is not required if the crewmember performs the drill required by Appendix 1 to JAR-OPS 1.1010 (b)(1)(i) and Appendix 1 to JAR-OPS 1.1015 (c)(3)(i) by **extinguishing an actual fire characteristic of an aeroplane interior fire**.

- 2 Amending **Conversion and Differences Training** and **Recurrent Training** to add the definitions or specifications for the following terms in cabin crew fire and smoke training:

- *Actual fire: an ignited combustible material, in controlled conditions, of sufficient magnitude and duration to accomplish the training objectives outlined in [proposed requirement (1)].*
- *Extinguish fire: to end the combustion process by removing or reducing any element of the fire tetrahedron (oxygen, heat, fuel, and chemical reaction) by actions of the cabin crew.*
- *Fire characteristic of an aeroplane interior fire: fire in locations representative of those on board the aeroplane(s) operated having the magnitude and behaviour relevant of the class(es) of fire likely to occur in those locations.*

Proposed Guidance Material

It is proposed that consideration be given by UK CAA (and/or EASA) to providing guidance material to address this subject based on the proposed change to future European aviation requirements above. In particular, the guidance material should explain the objectives of firefighting training and give examples or case studies of the different types of fires that can be used to accomplish those objectives.

8.3.8 **Safety, economic and Environmental Impacts**

Safety Impact

Due to the lack of specific requirements and guidelines, the variability of the standard of fire used in practical fire training across the industry was found to be quite high and the level of challenge was overall quite low. It is likely that the proposed training requirements would have a substantial effect in improving cabin crew skill in dealing with any in-flight fires and their attitude towards in-flight fire events.

Any enhancement to the volume of the fire to be extinguished by cabin crew in training would need to be considered in conjunction with requirements and/or restrictions in terms of Health and Safety and environment.

Economic Impact

The implementation of the proposed change is likely to incur some additional costs to operators and training organisations due to:

- Incremental costs related to the increased instructor man hours
- Incremental costs related to the increased cabin crew non-revenue time
- Incremental costs related to the required consumables, in this case fire source and fuel (e.g. material/wood, flammable liquid)
- Amendment and change to Training Manuals and Operations Manuals

Operators and training organisations already using actual (not gas-powered) fires during scenario training might need to carry out some modifications to their training facilities, equipment, or procedures.

There would be costs incurred to the authorities in developing the guidance material and costs related to the regulatory process in amending future European aviation requirements.

Environmental Impact

There will be some environmental impacts related with the use of combustible and flammable liquid fires, such as by-product gases from combustion and the use of wood or fuel.

8.3.9 **Summary**

Based on the findings from the review of current cabin crew fire training programmes, the online survey, and the review of non-civil aviation training programmes, it is evident that a set of standards for fires used in practical fire training needs to be provided. It was also found that this subject is addressed in US FAA and Transport Canada Civil Aviation regulatory material. Whilst the economic impacts need to be taken into consideration, addressing this subject in future European aviation requirements will ensure that an improved safety level can be achieved throughout the industry. Detailed guidance material will support the proposed requirements and ensure that operators adopt the best practice in carrying out practical fire training.

8.4 **Standards for Smoke Training**

8.4.1 **Description of Issue**

The study found that the conduct of smoke training using Protective Breathing Equipment (PBE) varied considerably amongst operators and training organisations. Consideration should be given to developing a standard for PBE training in a smoke-filled environment, including the minimum requirements for visibility and duration.

8.4.2 Scale of the Issue

The review of current cabin crew fire training programmes (see Section 2.2.5) found that the procedures and the realism of cabin crew training in the use of PBE (smoke training) varied significantly amongst operators/training organisations. For example, the density of smoke observed during the review varied from full visibility to approximately a half to one meter (two to three feet) visibility with no light. Another issue was the duration that the cabin crew actually wore PBE during practical training. For the operators and training organisations visited, this period varied from 20 seconds to seven minutes. The tasks that cabin crew carried out during training also varied from just walking through the smoke-filled environment to practicing various fire and evacuation/rescue scenarios in a cabin mock-up.

These findings were supported by the comments made in response to the online survey, which indicated that consideration needed to be given to establishing standards for smoke training methods/scenarios, in order to ensure that the objective of the smoke training could be achieved (see Section 3.5.2 and below).

As a comparison, the practical fire training observed at the Royal Navy used very high density smoke with minimum lighting during fire scenario training at the Fire Fighting Training Unit. During these training sessions, they practiced firefighting and evacuation scenarios wearing breathing apparatus and protective breathing equipment (see Section 4.1.5). The smoke training at the Royal Air Force was carried out separately from the fire training. During smoke training, an evacuation scenario was carried out in zero visibility following a simulated "crash" in a full-motion cabin simulator.

It was concluded that the differences in the training that were observed might in part be due to a lack of guidance material or specific training requirements in JAR-OPS 1. Therefore, consideration should be given to providing either guidance material or specific training requirements for PBE/smoke training.

Density of smoke

It is considered reasonable to have high density smoke to create low visibility during PBE/smoke training as this will prepare the cabin crew for the worst case scenario. The in-flight smoke incident on board a DHC8-400 on 4 August 2005 showed that even in a non-fire situation the visibility could be impaired significantly:

"...The cabin crew found the smoke in the cabin getting thicker, until they could no longer see the length of the cabin..."

This was also the case in a smoke occurrence during taxi on board a Fokker F100, 1 April 2002 at Manchester International Airport:

"...Both pilots looked back along the cabin through the open cockpit door and both remember having difficulty seeing as far as the rear of the passenger cabin..."

Very poor visibility in the cabin also occurred in the B707 accident in Orly, 11 July 1973 (see Appendix 3):

"The smoke was first white then black. Black smoke appeared on the cabin ceiling almost simultaneously in the tourist and first class cabins. It advanced horizontally and towards the floor. A crew member with a mask entered **the tourist cabin with zero visibility**. He saw 3 flashes occurring in the back of the plane. The blast threw him to the floor. He returned to the front. When he entered the cockpit, smoke could be seen in the cockpit for the first time. "

Zero visibility due to smoke has also occurred in the DC-9 accident in Cincinnati, 2 June 1983 (see Appendix 3):

"When the aeroplane began a steep descent, the smoke got heavier, intensified, increased in density and moved forward. **Dense smoke filled the cabin...**

... Several passengers said that when the flight attendants were walking down the aisles checking seat belts, it would have been **impossible to read the briefing cards at that time due to smoke.**

... *As soon as the aeroplane stopped, the man seated in 2B undid his seat belt and walked across the passageway to the front of the plane. He was engulfed by a **thick cloud of smoke**. He could not see anything nor could he feel anyone pushing against him. He heard coughing inside the cabin and sounds of people. Other passengers stated that by the time the aircraft landed, **they could not see their hands in front of their faces while seated or standing.**"*

Some respondents to the online survey commented on the lack of realism in their smoke training, supporting the need for more realistic conditions:

"Smoke filled cabin was poor, you could see where you were going, I feel if we have to be in a smoke filled cabin make it worse, so we can't see..." (Cabin Crew)

"During training the smoke conditions that we experienced were unrealistic. We were able to see from the front of the cabin to the back." (Cabin Crew)

Drills carried out during smoke/PBE training and duration of training

UK CAA CAP 360 Part 1 (withdrawn on 1 March 2006) specified that cabin crew had to don and use PBE in a smoke-filled environment for a minimum of five minutes whilst conducting some degree of workload. It would seem that whilst this is not a requirement of JAR-OPS 1, many operators implemented such criteria since they believed that it was of value.

It would be beneficial if the use of all relevant equipment is practiced during PBE/smoke training, as required by UK CAA CAP 648 (see Section 8.4.3). Ideally this should be carried out in an environment representative of, or similar to, the aircraft operated. Some of the comments from the online survey indicated that current smoke training practice needed to be improved to actually provide crew with the skills and experience in using PBE in a smoke-filled environment (see Section 3.5.2):

"It would be much more realistic to be on a mock-up of an aircraft that we work on, so we can experience what it would be like to be totally in the dark and thick smoke so we can try and locate our equipment. I personally think that it would be very hard to locate the equipment in the dark and with thick smoke even with our knowledge of equipment locations." (Cabin Crew)

"...the current practice of trying to locate a collection of hidden bags in a smoke filled cabin is in my opinion totally unrealistic and borders on being ridiculous. We should be practising real procedures in as realistic a situation as possible..." (Flight Crew)

This is in line with the French BEA recommendation following the B707 accident in Orly, 11 July 1973 (see Appendix 3):

"Instructions to personnel on the dangers of cabin fires, even limited ones, and on the importance to act on the fire itself without delay, and **training for this personnel in fire fighting and emergency procedures in a smoke-filled atmosphere.**"

8.4.3 **Associated Current Regulatory Material**

CONVERSION AND DIFFERENCES TRAINING – Appendix 1 to JAR-OPS 1.1010

(b) Fire and smoke training. An operator shall ensure that:

(1) Each cabin crew member is given realistic and practical training in the use of all fire fighting equipment including protective clothing representative of that carried in the aeroplane. This training must include:

(ii) The donning and use of protective breathing equipment by each cabin crew member in an enclosed, simulated smoke-filled environment.

RECURRENT TRAINING – Appendix 1 to JAR-OPS 1.1015

(c) An operator shall ensure that, at intervals not exceeding three years, Recurrent Training also includes;

(3) Each cabin crew member being given realistic and practical training in the use of all fire-fighting equipment, including protective clothing, representative of that carried in the aeroplane. This training must include:

(ii) The donning and use of protective breathing equipment by each cabin crew member in an enclosed, simulated smoke-filled environment.

There is no further guidance on the manner in which PBE/smoke training should be carried out. UK CAA CAP 360 Part 1 (withdrawn on 1 March 2006) specified that cabin crew should don and use PBE in a smoke-filled environment for a minimum of five minutes whilst conducting some degree of workload.

CAP 648 Chapter 8 (Recurrent Training) Paragraph 8.4.3 states:

Every three years the programme of training must include the following:

(d) The effects of smoke in an enclosed area and **actual use of all relevant equipment** in a simulated smoke-filled environment;

8.4.4 **Foreign Comparable Regulatory Material**

The US FAA and Transport Canada Civil Aviation cabin crew training requirements/ standards for PBE drills do not specify training in a smoke-filled environment or carrying out tasks other than operating fire extinguishers.

8.4.5 **Possible Change to Current Regulatory Material**

Training Affected

Conversion and Differences Training

Recurrent Training (3-yearly)

Recurrent Training (Annual)

Proposed Change to Future European Aviation Requirements

It is proposed that consideration be given by EASA to amending Conversion and Differences Training and Recurrent Training (3-yearly) to add the following:

An operator shall ensure that each cabin crew member dons PBE representative of the type and condition of that carried in the aeroplane, and that each cabin crew member wears PBE in an enclosed, simulated smoke-filled environment representative of the aeroplane operated. The training should include a task involving safety/emergency procedures relevant to the situation for no less than five minutes in minimum visibility.

It is proposed that consideration be given by EASA to amending Recurrent Training (Annual) to add the following:

An operator shall ensure that each cabin crew member dons PBE representative of the type and condition of that carried in the aeroplane.

Proposed Guidance Material

It is proposed that consideration be given by UK CAA (and/or EASA) to providing guidance material to address the standard and recommended practice of PBE/smoke training based on the proposed change to future European aviation requirements above. This should include guidance on the duration of the training in a smoke filled environment of a given level of visibility.

It is proposed that this guidance material contains guidelines on what aspects of the training environment (e.g. cabin mock-up) should be representative of the aircraft type operated. It is acknowledged that implementing certain aspects would be impractical and would only add a limited value to the training. For example, using a wide-body fuselage to represent the aircraft operated would require a considerable amount of time both to fill with smoke and to extract the smoke afterwards; however, depending on the type of task performed, it may not add much more value to the PBE training.

8.4.6 Safety, economic and Environmental Impacts

Safety Impact

It was observed that the variability of standard in the conduct of PBE/smoke training was quite appreciable and a poor standard existed in a number of operators/training organisations. The improved standard of PBE/smoke training associated with the proposed change is likely to have a substantial effect on improving cabin crew skill in implementing safety/emergency procedures during in-flight fire/smoke event. The proposed amendments to future European aviation requirements would ensure that this improvement affects the entire industry.

Economic Impact

PBE training in a smoke-filled environment is already required by JAR-OPS 1 and carried out by all operators, albeit with varying standards of visibility, duration, and tasks set to cabin crew. For operators already using an appropriate smoke training facility, it is unlikely that this amendment will incur any significant additional cost since the training resources are already in place.

It should be noted however, that some operators/training organisations may need to modify their smoke training facilities and/or smoke generation system or even acquire a cabin mock-up with smoke extraction and generation capability. There may be some

incremental costs related to the increased instructor man hours and cabin crew non-revenue time; however, this will not affect the entire industry since some operators/training organisations have been conducting the PBE/smoke training over and above the proposed required time. Most operators/training organisations will need to amend their Training Manuals and Operations Manuals.

There would be costs incurred to the authorities in developing the guidance material and costs related to the regulatory process in amending future European aviation requirements.

Environmental Impact

None identified.

8.4.7 Summary

Findings from the review of current cabin crew fire training programmes, the online survey, the review of non-civil aviation training programmes, and the accident/incident data analysis suggested that consideration needs to be given to the development of a standard for PBE training in a smoke-filled environment. Whilst the economic impacts need to be taken into consideration, addressing this subject in future European aviation requirements will ensure that an improved safety level can be achieved throughout the industry. Detailed guidance material will support the proposed requirements and ensure that operators adopt the best practice in carrying out practical PBE training.

8.5 Standards for Fire and Smoke Training Facilities

8.5.1 Description of Issue

The study found that the standard of fire and smoke training facilities varied considerably amongst operators and training organisations. Consideration should be given to standardising or setting a minimum requirement for fire and smoke training facilities.

8.5.2 Scale of the Issue

It was observed during the visits to operators and training organisations that in most cases the practical use of fire extinguishers was conducted in a different facility to the use of PBE in a smoke-filled environment. PBE training was usually conducted in a more representative cabin environment such as a cabin mock-up, whereas fire extinguisher training was usually conducted in an outdoor fire training rig.

This is corroborated by the comments received from the online survey. The comments indicated that smoke training facilities were fairly representative of an aircraft cabin but fire training facilities were usually not (see Section 3.5.4):

"Always done fire training outside in the cold on metal mock-ups which aren't always obvious as to what parts of aircraft they represent" (Cabin Crew)

"We do fire drills in a covered space outside with plenty of access and light and none of the difficulties of an in - cabin situation...." (Flight Crew)

"The oven fire fighting we do is not carried out in a mock-galley. It would be good to use a mock galley to practise in an area of limited space instead of just outside under a tin roof." (Cabin Crew)

The comments also indicated that there was a high variability in the standard of training facilities (see Section 3.5.4).

"There is too much variation in the location at which the fire training is carried out! Some places are excellent with realistic a/c mock-ups, whilst others are like

a shipping container - which although practical in its sturdy construction; bears absolutely no resemblance to an a/c! I have also found that given the time constraints on such mock-ups; there is usually a rushed approach to get everyone in the chamber to 'spray an extinguisher' and get out!" (Cabin Crew)

"So much depends on the operators level of practical equipment, I have experienced excellent, well funded facilities, but also many that are poor and certainly not compliant with JAR/CAA requirements." (Instructor)

Some respondents indicated that they believed there was an advantage in performing the complete fire training in a cabin simulator representative of their aircraft as compared to completing separate training in different facilities with low realism:

"The simulator sessions when we fought "fires" in the cabin were much more effective and allowed us to react the way we probably would in-flight however the outdoor training where we discharged a laser BCF at real flames was useless as it was expected and involved no realistic teamwork to fight the fire." (Cabin Crew)

"... Working in a proper simulated environment that mimics an actual aircraft (with the need to remove panels with crash axe, toilets, overhead lockers etc) would be much better than an outdoor metal box with gas burners that in no way resembles an aircraft or its confined environment and materials." (Cabin Crew)

At the US training organisation evaluated in this task, the training simulator replicates a corporate jet cabin (corporate jet operators are their main clients). Their fire training is conducted in a Gulfstream fuselage equipped with four circuit breaker fire scenarios comprising of two galley fires, one entertainment system fire, and one lavatory fire (see Section 2.2.2).

The fire training at the Royal Navy used an outdoor fire training facility for training on the use of fire extinguishers and fire hose, but a state-of-the-art firefighting facility was also used for scenario training where the crew practiced all elements of firefighting procedures and techniques (see Section 4.1.5).

Further definition on what the training objectives of practical fire training are, would help provide a clear direction on the training methods and the facilities/equipment required to accomplish those objectives.

8.5.3 **Associated Current Regulatory Material**

There is no minimum requirement or standard/guidance material for fire training facilities in terms of how representative it should be of the aircraft operated.

CAP 768 Chapter 29 Paragraph 11.1 specifies the areas of a training device for practical safety training and testing that should accurately represent the aircraft. However, this paragraph appears to be more directed towards evacuation training.

CAP 768 Chapter 29 Paragraph 11.1

If AOC holders use a representative training device for practical safety training and testing, it should accurately represent the aircraft in the following areas as appropriate.

- a) Layout of the cabin in relation to exits, emergency exits, galley areas and safety equipment stowage; dimensions should be an accurate representation typical of aircraft in the fleet.
- b) Both cabin crew and passenger seat positioning - with particular accuracy where these are immediately adjacent to exits.

- c) Seat dimensions and seat pitch.
- d) Operation of exits and emergency exits in all modes of operation - particularly in relation to method of operation and weight and balance.
- e) Extent of movement and associated forces of all controls for all equipment and services.
- f) Provision of the emergency equipment of the type provided in the aircraft.
- g) Cabin markings.
- h) Cabin lighting.
- i) Cabin crew communications equipment and associated control panels.
- j) Evacuation slides, including normal and standby methods of operation.
- k) Height and angle of inflated evacuation slides.

8.5.4 **Foreign Comparable Regulatory Material**

TCCA Flight Attendant Training Standard (Reference 10) for Equipment Criteria for Initial (7.8.3 a) and Annual (7.6.3 a) Fire Fighting Training requires that:

Fire fighting drills shall be conducted using aircraft furnishings as found on the operator's aircraft as appropriate to the drill scenario (e.g. seats, galley units, panels, waste bins, etc.).

In the Performance Criteria for Initial (7.8.6 a) Fire Fighting Drill it is stated that:

7.8.6 a. Each trainee shall demonstrate the ability to **carry out fire fighting procedures in a cabin environment** as a primary fire fighter and perform the following:

- i) Recognize that there is a potential fire situation (e.g. smoke detector signal or unusual fumes, odours, etc.);
- ii) Locate the source of fire;
- iii) Apply communication and co-ordination procedures;
- iv) Select and remove the nearest appropriate fire extinguisher and (if applicable) other fire fighting equipment;
- v) Inform, assist and control passengers;
- vi) Operate the extinguisher; and
- vii) Monitor for re-ignition, and apply post-fire follow-up procedures.

(Similar to Performance Criteria for Annual Fire Fighting Drill (7.6.4 a))

8.5.5 **Possible Change to Current Regulatory Material**

Training Affected

Conversion and Differences Training

Recurrent Training

Proposed Guidance Material

It is proposed that consideration be given by UK CAA (and/or EASA) to providing guidance material addressing further definition of the objectives of practical fire training. This guidance material should provide a clear direction on the training methods and the attributes of facilities/equipment required to effectively achieve those objectives.

8.5.6 **Safety, economic and Environmental Impacts**

Safety Impact

It is likely that standardising the fire and smoke training facilities would have a substantial effect in improving the quality of fire and smoke training and the standard of skill and confidence of cabin crew in dealing with in-flight fire/smoke events.

Considering that a reasonable number of operators and training organisations were observed to be carrying out practical fire and smoke training in facilities with poor realism, the implementation of standards for fire and smoke training facilities would improve the quality of training across the industry.

Economic Impact

Adopting the standard is likely to incur some additional costs to some operators, due to the acquisition of training facilities such as cabin mock-up, modifications of existing training facilities such as installation of a smoke extractor system, or increased cost in using 'third-party' training facilities. The extent of the economic impact would vary amongst operators.

There would be costs incurred to the authorities in developing the guidance material.

Environmental Impact

None identified.

8.5.7 **Summary**

Findings from the review of current cabin crew fire training programmes, the online survey, and the review of non-civil aviation training programmes suggested that consideration needs to be given to providing a standard for fire and smoke training facilities. It was found that, although not explicit, Transport Canada Civil Aviation regulatory material addresses this issue. Guidance material addressing practical training objectives and the minimum requirements for fire and smoke training facilities would provide guidelines on the best practice in carrying out practical fire and smoke training scenarios and ensuring that the objectives are met.

8.6 **Standards for Fire Training Instructors**

8.6.1 **Description of Issue**

The study found that there is a need for standards that fire training instructors shall meet in order to ensure that the training conducted achieves the objectives of the JAR-OPS 1 requirements and be totally consistent with the operator's Training Manual and Operations Manual.

8.6.2 **Scale of the Issue**

The review of current cabin crew fire training programmes found that some of the training provided by 'third-party' instructors having little or no experience of aircraft flight operations lacked the operator-specific and flight operations elements of the fire training (see Section 2.9 and 8.21 – Requirement for the Regulation of Training Provided by 'Third-Party' Training Organisations). On the other hand, some comments indicated that fire training provided by in-house cabin crew instructors did not meet their expectations (see Section 3.12):

" The practical training is carried out by cabin crew trainers but I feel it should be carried out by fire fighting professionals. It also fails to realistically simulate our unique firefighting environment." (Flight Crew)

"If done 'in house', that is by the airline itself, training is usually rushed and devalued. If done by outside contractor, training is usually to a higher standard."
(Flight Crew)

Additionally, responses to the online survey indicated that there was a high variability in the standard of fire training instructors (see Section 3.12):

"I have experienced a wide range of fire instructors training skills ranging from excellent to poor (technical knowledge of the subject has always been high)."
(Instructor)

"Standard of Recurrent Training varied greatly from airline to airline, and from instructor to instructor, in my experience." (Flight Crew)

"Generally the average student will take on board this info readily, however the information that is used can often be out of date and sometimes incorrect. I worked with several airlines all of which had very differing standards for their staff." (Instructor)

From the visit to the Royal Navy, it was established that Royal Navy instructors (and the 'third-party' instructors they used) are of a high standard. Royal Navy instructors have completed fire training to an advanced level and work closely with the 'third-party' instructors. These 'third-party' instructors are actual fire fighters who are familiar with the Royal Navy training requirements and firefighting procedures (see Section 4.1). At the US training organisation evaluated in this study, the instructors have attended aircraft specific training with their airport fire department, and several instructors are part-time fire fighters (see Section 2.9).

It is therefore concluded that, since training quality depends heavily on the instructor's training skills, consideration should be given to establishing a qualification standard for cabin crew fire training instructors.

8.6.3 **Associated Current Regulatory Material**

Although JAR-OPS 1 requires that Initial, Conversion and Differences, and Recurrent Training be conducted by "suitably qualified persons", no standard for such persons was specified for fire and smoke training.

INITIAL TRAINING – Appendix 1 to JAR-OPS 1.1005

- (a) An operator shall ensure that all elements of Initial Training are conducted by suitably qualified persons.

CONVERSION AND DIFFERENCES TRAINING – Appendix 1 to JAR-OPS 1.1010

- (a) General. An operator shall ensure that:
 - (1) Conversion and Differences Training is conducted by suitably qualified persons

RECURRENT TRAINING – Appendix 1 to JAR-OPS 1.1015

- (a) An operator shall ensure that Recurrent Training is conducted by suitably qualified persons.

CAP 768 Chapter 29, Paragraph 4.1 states:

A suitably qualified person should be appointed to manage cabin safety training and testing; additionally instructors and examiners will need to be appointed to provide instruction, supervise practical training and conduct tests. Cabin crew practical training should be under the supervision of an instructor **who has the knowledge, ability and experience to conduct such training.**

It may be argued that no standards have been specified for any other aspect of cabin crew training, apart from CRM training where there is a set standard applied (at least by the UK CAA). However, training in firefighting requires specialised skills and knowledge on the part of the instructor.

8.6.4 **Foreign Comparable Regulatory Material**

There is no standard for fire and smoke training instructors in either Transport Canada Civil Aviation or FAA regulatory material.

8.6.5 **Possible Change to Current Regulatory Material**

Training Affected

Initial Training

Conversion and Differences Training

Recurrent Training

Proposed Change to Future European Aviation Requirements

It is proposed that consideration be given by EASA to amending Initial Training, Conversion and Differences Training, and Recurrent Training to add the following:

An operator shall ensure that all persons conducting theoretical and practical fire training have the necessary experience and qualifications to effectively deliver the training requirements of this Subpart, and this should include the personnel of 'third-party' training organisations providing such training.

Proposed Guidance Material

It is proposed that consideration be given by UK CAA (and/or EASA) to providing guidance material addressing the necessary experience and qualifications for fire training instructors. This should address training organisations whose instructors may have little or no experience of an aircraft flight operations environment, even though they may be experts in firefighting. The guidance material should also address the required firefighting knowledge and skills of in-house instructors.

8.6.6 **Safety, economic and Environmental Impacts**

Safety Impact

Since it was found that the quality of training depends heavily on the knowledge, experience and skill of instructors, it is likely that the introduction of a standard for fire training instructors would have a substantial effect in improving the quality of crew fire training across the industry.

Economic Impact

The introduction of a standard for fire training instructors is likely to incur costs in ensuring that the in-house and 'third-party' instructors meet the qualifications (e.g. through further training, workshops, etc.). Other costs are mostly related to amendment and change to Training Manuals and Operations Manuals.

There would be costs incurred to the authorities in developing the guidance material and costs related to the regulatory process in amending future European aviation requirements.

Environmental Impact

None identified.

8.6.7 **Summary**

Findings from the review of current cabin crew fire training programmes, the online survey, and the review of non-civil aviation training programmes suggested that consideration should be given to establishing standards for fire training instructors. Whilst the economic impacts need to be taken into consideration, addressing this subject in future European aviation requirements will ensure that an improved safety level can be achieved throughout the industry. Detailed guidance material will support the proposed requirements and ensure that instructors have the necessary experience and qualifications to effectively deliver the training requirements.

Other Recommendations

It is recommended that consideration be given to establishing a forum for instructors where information regarding training procedures, equipment, etc. could be shared among operators and training organisations.

8.7 **Evaluation Criteria in Practical Fire and Smoke Training**

8.7.1 **Description of Issue**

The study found that there were no evaluation criteria in terms of the level and type of skills that need to be acquired and demonstrated by cabin crew in respect of practical fire and smoke training. Based on the findings of the online survey, the absence of standardised evaluation criteria to confirm cabin crew's proficiency in practical fire and smoke training had adversely affected the conduct of training and possibly teamwork during flight operations. It was concluded that consideration should be given to establishing standardised evaluation criteria that should be implemented during practical fire and smoke training to address this issue.

8.7.2 **Scale of the Issue**

JAR-OPS 1 requirements provide no criteria addressing what should be expected in terms of demonstrating proficiency during practical fire and smoke training and therefore such criteria are left to individual operators and national aviation authorities to determine.

The online survey highlighted many comments from UK respondents who were concerned with this issue and how it had influenced the conduct of training (see Section 3.9). Some of the relevant comments included:

"Time is sufficient, however during practical training anyone with asthma or any other medical condition doesn't have to carry out the exercise where we are required to enter smoke filled cabin wearing smokehood. What exactly are they going to do in a real emergency!?" (Cabin Crew)

"Everyone should have to do proper fire drills with scenarios and exams in the same we do the various evacuation drills." (Cabin Crew)

"There needs to be a more competence based approach to training so that knowledge and understanding can be confirmed." (Instructor)

"The fire training plan used by my airline aims to train the cabin crew and flight crew in fighting fires in the cabin. However, when crew do not carry out the drill successfully, there is no PASS/FAIL element emphasised by the trainers. So usually a facilitative debrief is carried out and no re-test taken. This gives the impression to crew that getting it wrong is ok." (Flight Crew)

"Cabin crew often fail to carry out the proper procedures and fail to extinguish the fire BUT they are still released to the line." (Flight Crew)

As a comparison, the US training organisation evaluated in this study conducts examinations to confirm trainees' proficiency in both theory and drill. The trainees are debriefed after each scenario drill and they will repeat the exercise if necessary at a later point in training (see Section 2.8).

The lack of standardised evaluation criteria, across the industry, resulted in different standards of training and hence variations in the cabin crew's capability to deal with fires. There were also indications that it has adversely affected teamwork amongst crew members (see Section 3.9). Comments received from the online survey indicated that this was due to their lack of confidence in the ability of other crew members to deal with fires, as reflected below:

"I am confident in fighting a fire myself. However I would have doubts with some of my other crew members." (Cabin Crew)

"... My feeling is that there are some crew who I would feel confident in working with to deal with a fire situation, yet there are some who I would not want to be in that situation with. Attitudes and abilities vary and this is exacerbated by the fact that we are always working with people we don't know - due to size of operation and scheduling." (Cabin Crew)

8.7.3 **Associated Current Regulatory Material**

The requirements relevant to fire and smoke training in Conversion and Differences Training and Recurrent Training do not provide any criteria in respect of what should be expected in terms of evaluating cabin crew proficiency.

JAR-OPS 1.1025 (requirement for Checking) requires that:

- (a) An operator shall ensure that during or following completion of the training required by JAR-OPS 1.1005, 1.1010 and 1.1015, each cabin crew member undergoes a check covering the training received in order to verify his proficiency in carrying out normal and emergency safety duties. These checks must be performed by personnel acceptable to the Authority.
- (b) An operator shall ensure that each cabin crew member undergoes checks as follows:
 - (1) Initial Training. The items listed in Appendix 1 to JAR-OPS 1.1005;
 - (2) Conversion and Differences Training. The items listed in Appendix 1 to JAR-OPS 1.1010; and
 - (3) Recurrent Training. The items listed in Appendix 1 to JAR-OPS 1.1015 as appropriate.

In UK CAA CAP 648 (Specimen A to B Standard Operations Manual (Aeroplanes)), it is stated in Section 2.2 Cabin Crew Training and Checking JAR-OPS 1 (Subpart O) that pass/fail criteria should be specified in Checking:

8 Checking

1.1025, AMC 1.1025

8.1 The pass/fail criteria should be specified.

8.2 Procedures for resits should be specified.

However, there is very little evidence that any pass/fail criteria for practical fire and smoke training are implemented.

8.7.4 Foreign Comparable Regulatory Material

TCCA Flight Attendant Training Standard (Reference 10) provides a set of evaluation criteria in Fire Fighting Drill during Initial (7.8.7) and Annual (7.6.5) Training:

- a. Trainee performance shall be observed, rated and debriefed according to:
 - i. Recognition or identification of the problem;
 - ii. Correctly locates the source of the fire (e.g. tactile search, use of crash axe, etc.);
 - iii. Effective communication/coordination procedures throughout the drill (e.g. notifying fellow crew members of the situation, establish and maintain communication with the flight deck, providing clear, concise information to the pilot-in-command, advice assistance to passengers; etc.);
 - iv. Responds in a timely manner;
 - v. Correct usage of fire fighting equipment consistent with the type of fire, location of the fire and maximum effective position of the fire extinguisher;
 - vi. Undertake further action as required; and
 - vii. Consequences of error.

The US Federal Aviation Regulation for Part 121 Subpart N Section 121.417 (Reference 11) requires that:

- (d) After September 1, 1993, no crewmember may serve in operations under this part unless that crewmember has performed the PBE drill and the firefighting drill described by paragraphs (c)(1)(i) and (c)(1)(ii) of this section, as part of a one-time training requirement of paragraphs (c)(1) or (c)(2) of this section as appropriate. Any crewmember who performs the PBE drill and the firefighting drill prescribed in paragraphs (c)(1)(i) and (c)(1)(ii) of this section after May 26, 1987, is deemed to be in compliance with this regulation upon presentation of information or documentation, in a form and manner acceptable to the Director, Flight Standards Service, showing that the appropriate drills have been accomplished.

(Where (c)(1)(i) requires that each crew member performs the PBE drill and (c)(1)(ii) requires that each crew member combats an actual fire.)

14 CFR 121.417 defines "combat", in this context, as "*to properly fight an actual or simulated fire using an appropriate type of fire extinguisher until that fire is extinguished.*" 14 CFR 121.417 also defines "perform" as "*to satisfactorily accomplish a prescribed emergency drill using established procedures that stress the skill of the persons involved in the drill.*"

8.7.5 Possible Change to Current Regulatory Material

Training Affected

Conversion and Differences Training

Recurrent Training (3-yearly)

Proposed Change to Future European Aviation Requirements

It is proposed that consideration be given by EASA to amending Conversion and Differences Training and Recurrent Training to add the following:

An operator must ensure that each cabin crew member's performance in carrying out

practical fire and smoke training is individually observed, rated and they are debriefed in the following subjects:

- *Recognition of potential fire threats;*
- *Location of the fire source and its severity;*
- *Coordination and communication procedures with other cabin crew and the flight crew;*
- *Immediate, aggressive and proper fire fighting actions using all appropriate safety equipment;*
- *Management of passengers;*
- *Monitoring for fire re-ignition and post-fire procedures.*

Proficiency in the above items shall be demonstrated by each cabin crew member on an individual basis and shall be reflected in the Training Records required by JAR-OPS 1.1035.

Proposed Guidance Material

It is proposed that consideration be given by UK CAA (and/or EASA) to providing guidance material to address cabin crew evaluation criteria for fire and smoke training, based on the proposed change to future European aviation requirements above.

8.7.6 **Safety, economic and Environmental Impacts**

Safety Impact

It was observed that the absence of evaluation criteria for practical fire and smoke training was likely to affect cabin crew fire training across the industry. This could be one of the factors influencing the quality and effectiveness of training. It is likely that implementing the standardised evaluation criteria would have a substantial effect in improving the overall standard of training programmes and cabin crew skills in dealing with an in-flight fire/smoke event.

Economic Impact

The implementation of the proposed change is likely to incur some additional costs to the operators due to:

- Incremental costs related to the increased instructor man hours.
- Incremental costs related to the increased cabin crew non-revenue time.
- Amendment and change to Training Manuals and Operations Manual.

There would be costs incurred to the authorities in developing the guidance material and costs related to the regulatory process in amending future European aviation requirements.

Environmental Impact

None identified.

8.7.7 **Summary**

Based on the findings from the review of current cabin crew fire training programmes, the online survey, and the review of non-civil aviation training programmes, it is evident that consideration should be given to providing standardised evaluation criteria for cabin crew's performance in practical fire and smoke training. It was also found that this subject is addressed in US FAA and Transport Canada Civil Aviation regulatory material. Whilst the economic impacts need to be taken into consideration, addressing this subject in future European aviation requirements will ensure that an

improved safety level can be achieved throughout the industry. Detailed guidance material will support the proposed requirements and ensure that operators adopt the best practice in evaluating cabin crew's proficiency in practical fire and smoke training.

8.8 Theoretical Training in Fire Prevention Measures

8.8.1 Description of Issue

The study found that a high proportion of in-flight fire/smoke events could have been prevented had the cabin crew involved exercised more caution in using galley appliances. JAR-OPS 1 requirements address the necessity for frequent checking of potential fire-risk areas in Initial Training; however, instructions on other fire prevention measures are not addressed. Additionally, none of these subjects is included in Conversion and Differences Training and Recurrent Training.

8.8.2 Scale of the Issue

The majority of oven fires and trash compactor/waste bin fires reported in UK MORs in the period 2002-2006 were associated with cabin crew negligence and unsafe work habits. As mentioned in Section 5.1, cabin crew negligence/unsafe work habit is the primary causal factor in 73 out of the 131 in-flight oven fire/smoke events and three out of four trash compactor/waste bin fires.

*"Rear galley oven caught fire on ground as pax meals were being cooked - **oven glove discovered between oven and housing**. Fire discovered by cabin crew, standard firefighting procedure adopted. Flight crew informed of successful outcome with fire extinguished and cause discovered and removed. One BCF discharged, aircraft considered safe for despatch."*

*"The purser in the rear galley noticed a burning smell from the brewer and on investigation a tea bag was found to have burnt in the tea pot due to lack of water. **The tea bag was thrown into the trash compactor and moments later smoke and fumes were noticed emanating from it.** A BCF extinguisher was discharged into the compactor and the smoke/fumes dissipated. The extinguisher was later used to damp down the contents of the compactor and the waste was removed. The purser was then briefed to make sure that any burnt items are damped down before being thrown in the trash."*

JAR-OPS 1 requirements do address the checking of fire risk areas and associated smoke detectors during Initial Training; however other everyday fire prevention measures that are to be taken in order to minimise the risk of fire are not addressed. Additionally, none of these subjects is included in Conversion and Differences Training and Recurrent Training.

8.8.3 Associated Current Regulatory Material

INITIAL TRAINING – Appendix 1 to JAR-OPS 1.1005 (Amendment 13)

(b) Fire and Smoke Training. An operator shall ensure that fire and smoke training includes:

(3) The necessity for frequent checking of potential fire-risk areas including toilets, and the associated smoke detectors

As previously mentioned, there are no specific requirements related to fire prevention and safe work habits in Conversion and Differences Training and Recurrent Training.

CAP 768 Chapter 33 Paragraph 4.1 states:

Cabin crew should maintain surveillance in the aircraft cabin and galley areas for potential fires. Additionally, a frequent check of toilet areas and other remote areas

such as crew rest compartments should be undertaken, noting in particular that smoke detectors remain unblocked.

CAP 768 Chapter 33 Paragraph 5.1 to 5.3 explains in detail the risks and prevention measures related to oven fires.

8.8.4 **Foreign Comparable Regulatory Material**

TCCA Flight Attendant Training Standard (Reference 10) for Fire Fighting Training lists a set of required knowledge necessary for fire prevention (Ref. TP 12296 Section 4.1B.4/Initial and 4.1B.1/Annual), beyond that specified in the current JAR-OPS 1 requirement above..

List fire prevention measures and crew responsibilities for fire prevention including but not limited to:

- a. Practicing and maintaining safe work habits;
- b. Enforcing smoking regulations;
- c. Monitoring cabin, lavatories, cargo compartments;
- d. Awareness of popped circuit breaker procedures; and
- e. Prompt investigation of fire detection alarms, unusual odours, heat build-up, deformation of aircraft components, etc.

The US FAA General Technical Administration Volume 3 Chapter 23 Section 6 (Reference 13) Paragraph 3-1851 (Fire Prevention) B to D included information on fire prevention measures related to the safe use of galley ovens and fire risks associated with lavatory waste containers and smoking.

8.8.5 **Possible Change to Current Regulatory Material**

Training Affected

Conversion and Differences Training

Recurrent Training (3-yearly)

Proposed Change to Future European Aviation Requirements

Although theoretical fire training is only specified in Appendix 1 to JAR-OPS 1.1005 (Initial Training), it is considered essential that this training is carried out during Conversion and Differences Training (due to its aircraft type-specific information) and Recurrent Training (to ensure knowledge retention). Therefore, it is proposed that consideration be given by EASA to amending Conversion and Difference Training and Recurrent Training to add the following:

“An operator shall ensure that cabin crew are trained in general fire prevention measures, including safe work habits, as well as the specifics relevant to the aeroplane type to be operated and the systems and equipment installed”.

Proposed Guidance Material

It is proposed that consideration be given by UK CAA (and/or EASA) to providing guidance material pertinent to this subject, taking into account the information contained in CAP 768, FAA AC 120-80, FAA Air Operator Technical Administration on Cabin Safety and Flight Attendant Training, and TCCA Flight Attendant Training Standard (TP 12296 Issue 05).

8.8.6 **Safety, economic and Environmental Impacts**

Safety Impact

Considering that the frequency of in-flight fire/smoke events that could have been prevented by cabin crew practicing and maintaining safe work habits was found to be fairly high, the implementation of the proposed training could reduce the frequency of such in-flight fire/smoke events considerably.

Economic Impact

Prevention of in-flight fire/smoke events by maintaining safe work habits could benefit the operators economically by avoiding operating cost penalties associated with aircraft diversion or returning to base due to such events. However, the implementation of the proposed change is likely to incur some additional costs to the operator due to:

- Incremental costs related to the increased instructor man hours.
- Incremental costs related to the increased cabin crew non-revenue time.
- Amendment and change to Training Manuals and Operations Manuals.

There would be costs incurred to the authorities in developing the guidance material and costs related to the regulatory process in amending future European aviation requirements.

Environmental Impact

None identified.

8.8.7 **Summary**

Based on the findings from the accident/incident data analysis and review of JAR-OPS 1 requirements, it is evident that training in prevention measures and safe work habits needs to be expanded. It was also found that this subject is addressed in US FAA and Transport Canada Civil Aviation regulatory material. Whilst the economic impacts need to be taken into consideration, addressing this subject in future European aviation requirements will ensure that an improved safety level can be achieved throughout the industry. Detailed guidance material will support the proposed requirements and ensure that operators adopt the best practice in carrying out training in prevention measures.

8.9 **Theoretical Training in Communication/Coordination with Flight Crew During an In-Flight Fire/Smoke Event**

8.9.1 **Description of Issue**

The study suggests that theoretical fire training for cabin crew might be deficient with regard to their awareness of likely flight crew workload during emergency situations. JAR-OPS 1 requirements do not address this issue. Furthermore, JAR-OPS 1 does not define the information that should be conveyed to the flight crew regarding an in-flight fire, and the manner in which it should be communicated.

Lack of training in this subject could result in ineffective communication between cabin crew and flight crew during an in-flight fire event, which could adversely affect the decisions made by the flight crew.

8.9.2 **Scale of the Issue**

Problems in communication/coordination between cabin crew and flight crew accounted for 10% of the problems identified by those who had experienced an in-flight fire/smoke event, as reported in the online survey by UK respondents (see Section 3.7). The incident data analysis found that this problem accounted for 7% of the problems cited in MORs (see Section 5.3).

The review of cabin crew fire training programmes found that in most cases, the cabin crew were not made aware of the high level of flight crew workload during an in-flight emergency when the flight crew were likely to be planning for a diversion and emergency descent or landing (see Section 2.4). Comments made by the respondents in the online survey corroborated this issue (see Section 3.6.2), as shown below:

"The procedures for the communicator tend to make them think a "running commentary" is required. In the real event the flight crew would need information, but would also need a lot more time to communicate with each other and ATC. They would also need some thinking time and a meaningless string of words over the interphone (which is very loud) would not help at all. They should be briefed to tell us of changes and be on the line to answer questions, but not turn into a DJ." (Flight Crew)

"I was once the "communicator" in a small electrical fire on board. When I called to inform the captain of the incident I was under the impression (according to my S.E.P. manual) that we were to maintain constant communication throughout the incident but instead I was told by the captain to call back "...when something changes"! I believe that the flight crew once notified of an incident such as a fire are extremely busy and maintaining constant communication might be unrealistic therefore I believe that we should follow a different procedure." (Cabin Crew)

Cabin crew's lack of knowledge of flight crew's workload during an emergency situation was found to be an issue in an incident involving a DHC-8-400, which experienced a build-up of smoke in the flight deck and the cabin. According to AAIB Bulletin 4/2007 (EW/C2005/08/10):

"In their reports on the incident the flight crew noted that, after the emergency had been declared, a high workload had prevented them from communicating with the cabin crew for some time. The cabin crew commented that delays in obtaining a response from the flight deck to cabin emergency calls at times had caused concern as to the state of the flight crew. It was suggested that consideration should be given to introducing a standard method by which the flight crew could confirm to the cabin crew that they were not incapacitated but were temporarily too busy to reply, such as a triple activation of the seat belt audio alert in the cabin."

Additionally, the review of cabin crew fire training programmes found that whilst the cabin crew were trained in general terms about the information required by the flight crew, in some cases the training on specific information differed (see Section 2.4). On this subject, the NTSB made the following recommendations following their investigation into the accident to the DC-9 in Cincinnati on the 2nd June 1983:

*"The NTSB recommends that the FAA: require that Air Carrier Principal Operations Inspectors review the training programs of their respective carriers and if necessary specify that they be amended to emphasize requirements: - For flightcrews to take immediate and aggressive action to determine the source and severity of any reported cabin fire and to begin an emergency descent for landing or ditching if the source and severity of the fire are not positively and quickly determined or if immediate extinction is not assured. - **For flight attendants to recognize the urgency of informing flightcrews of the location, source, and severity of any fire or smoke within the cabin.** - For both flightcrews and flight attendants to be knowledgeable of the proper methods of aggressively attacking a cabin fire by including hands-on-training ..."*

8.9.3 **Associated Current Regulatory Material**

The current Initial Training requirement relating to communication with flight crew does not address flight crew workload or specify what information the flight crew would need during an in-flight fire situation:

INITIAL TRAINING – Appendix 1 to JAR-OPS 1.1005

(b) Fire and smoke training. An operator shall ensure that fire and smoke training includes:

(2) The importance of informing the flight crew immediately, as well as the specific actions necessary for coordination and assistance, when fire or smoke is discovered;

(g) Communication. An operator shall ensure that, during training, emphasis is placed on the importance of effective communication between cabin crew and flight crew including technique, common language and terminology.

UK CAA CAP 768 Chapter 33 Paragraph 4.2 states that:

On discovering a fire and/or smoke, the flight crew should be informed immediately of its **location, source and severity and be kept informed as the situation develops.**

8.9.4 **Foreign Comparable Regulatory Material**

TCCA Flight Attendant Training Standard (Reference 10) for Initial (4.1B.6) and Annual (4.1B.3) Fire Fighting Training does not address flight crew workload issues, but it requires cabin crew members to:

Describe the importance of crew communication in fire fighting and providing pilot-in-command with accurate information on fire source, location, extent/severity or fire/smoke, fire fighting actions.

The US Federal Aviation Regulation for Part 121 Subpart N Section 121.417 (b)(1) (Reference 11) on coordination among crew members in emergency training does not specifically address communication between cabin crew and flight crew during an in-flight fire event.

8.9.5 **Possible Change to Current Regulatory Material**

Training Affected

Initial Training

Recurrent Training (3-yearly)

Proposed Change to Future European Aviation Requirements

It is proposed that consideration be given by EASA to amending Initial Training to modify the following requirements:

(b) Fire and smoke training. An operator shall ensure that fire and smoke training includes:

- (2) The importance of providing the flight crew with **accurate information on the fire or smoke location, source and severity and the firefighting actions being undertaken**, as well as the specific actions necessary for coordination and assistance, when fire or smoke is discovered;

- (g) Communication. An operator shall ensure that, during training, emphasis is placed on the importance of effective communication between cabin crew and flight crew including technique, common language and terminology, **taking into account the likely flight crew workload during emergency situations.**

It is proposed that consideration be given by EASA to amending Recurrent Training to add the following:

An operator shall ensure that fire and smoke training includes the importance of providing the flight crew **with accurate information on the fire or smoke location, source and severity and the firefighting actions being undertaken** when fire or smoke is discovered, taking into account the likely flight crew workload during emergency situations.

Proposed Guidance Material

It is proposed that consideration be given by UK CAA (and/or EASA) to providing guidance material with regard to training for cabin crew members in:

- 1 The likely flight crew workload during an emergency situation.
- 2 The information that should be provided to the flight crew regarding fire or smoke location, source and severity and the firefighting action being undertaken, together with other pertinent information (e.g. any adverse effects on passengers and cabin systems).
- 3 The importance of informing the flight crew immediately fire or smoke is detected and keeping them informed of any significant developments.
- 4 The importance of the communications being brief, clear and succinct.

8.9.6 Safety, economic and Environmental Impacts

Safety Impact

Lack of knowledge of flight crew workload and the information required to communicate to flight crew during an in-flight fire/smoke event appeared to be quite prevalent in the majority of cabin crew. This problem is likely to have an effect on the safety of the flight related to the possibility of incorrect or inappropriate decisions being made by the flight crew due to inaccurate information or procedure. It is likely that the proposed change will have a significant effect in mitigating the problems associated with this subject.

Economic Impact

The implementation of the proposed change is likely to incur some additional costs to the operators due to:

- Incremental costs related to the increased instructor man hours.
- Incremental costs related to the increased cabin crew non-revenue time.
- Amendment and change to Training Manuals and Operations Manuals.

There would be costs incurred to the authorities in developing the guidance material and costs related to the regulatory process in amending future European aviation requirements.

Environmental Impact

None identified.

8.9.7 Summary

Findings from the review of current cabin crew fire training programmes, the online survey, and the accident/incident data analysis suggested that the issue related to flight crew workload and specific communication procedures with flight crew during an in-flight fire/smoke event needs to be addressed in theoretical fire training. It was also found that this subject is addressed in Transport Canada Civil Aviation regulatory material. Whilst the economic impacts need to be taken into consideration, addressing this subject in future European aviation requirements will ensure that an improved safety level can be achieved throughout the industry. Detailed guidance material will support the proposed requirements and ensure that operators adopt the best practice in carrying out theoretical training in communication and coordination with flight crew during an in-flight fire/smoke event.

8.10 Practical Training in Communication/Coordination with Flight Crew During an In-flight Fire/Smoke Event

8.10.1 Description of Issue

Based on the study, it was evident that consideration needed to be given to require cabin crew practical training in communicating/coordinating with flight crew. Ideally, such training should be carried out jointly with the flight crew, with and without the use of an interphone, and involve the use of PBE. JAR-OPS 1 requirements do not address this subject.

8.10.2 Scale of the Issue

The need for joint practical training in communication/coordination with flight crew

The review of UK/European cabin crew fire training programmes found that only four out of the ten operators/training organisations visited included flight crew in cabin crew fire training. The US training organisation evaluated in this study involves the flight crew during cabin crew fire training which also includes communication and coordination procedures (see Section 2.6). The crew fire training observed at the RAF also involved flight crew (see Section 4.2.4); however, communication/coordination procedures were not actually practiced between the flight crew and cabin crew (stewards/loadmasters).

The review concluded that given the little time that both flight crew and cabin crew might have to respond effectively to a fire threat, it would seem reasonable that consideration should be given to placing more emphasis on joint training, which could also include many CRM elements, as required by JAR-OPS 1. UK CAA FODCOM 40/2007 recommended that *"to ensure a better understanding of both flight and cabin crew actions and procedures, joint practical training should be carried out where possible"*.

The online survey found that communication/coordination between cabin crew and flight crew accounts for 10% of the problems identified by respondents who had experienced an in-flight fire/smoke event (see Section 3.7). Some of the respondents' comments indicated the need for joint practical fire/smoke training with flight crew (see Section 3.6.2), as cited below:

“There needs to be comprehensive training in the interaction between Flight Deck and Cabin Crew for serious fire/smoke/fumes scenarios.” (Flight Crew)

“Flight crew's knowledge of the cabin crew roles in a fire fighting drill are very poor. From my experience they do not appreciate the workloads of the cabin crew during this and are often overly critical of the cabin crew. There is no way near enough joint training so both cabin and flight crew can see each others roles/responsibilities.” (Flight Crew)

The incident/accident data analysis found that 7% of the problems cited in the MOR data analysed in the study were related to communication/coordination between cabin crew and flight crew (see Section 5.3), for example:

“... Both pilots were aware of continued banging on the locked cockpit door, which had commenced after their failed attempts to reply to the cabin crew on the interphone. This heightened the pilots' concerns about what was happening, since they were unable to either communicate with the cabin crew or establish the cause of the smoke...”

The need for practical training in communication whilst wearing PBE

The review of cabin crew fire training programmes found that although the instructors indicated the difficulties of communicating when wearing PBE, there was little in the practical training to address this especially in conjunction with the use of a PA/interphone handset for communication with the flight crew (see Section 2.4).

Difficulty in communicating whilst wearing PBE was also the subject of some of the comments received from the online survey (see Section 3.7).

“Very difficult to communicate effectively with anyone when wearing the [Manufacturers Name] smokehood. All parties found this a definite obstacle...” (Cabin Crew)

Communication while wearing PBE was the main issue in an incident involving a DHC-8-400, which experienced a build-up of smoke in the flight deck and the cabin. According to AAIB Bulletin 4/2007 (EW/C2005/08/10):

“Because of hearing difficulties caused by the smoke hoods, the cabin crew members did not hear the landing calls from the flight deck.

The cabin crew also reported that the smoke hoods had severely hindered communications with the passengers, impeding both hearing and being heard. Because of this, one of the cabin crew had removed her hood shortly before landing.

Checks made during the investigation confirmed that verbal communications while wearing a cabin crew smoke hood were difficult, even when in close proximity to another person. This was due to the combination of a reduction in speech and hearing volume due to the hood and to interference from relatively loud sounds perceived by the hood wearer, caused by rustling of the hood, the sound of the wearer's breathing and the sound of the wearer's voice.”

The AAIB report stated that while the cabin crew members had undergone training with smoke hoods, it appeared that this had not fully prepared them for the extent of the associated communication difficulties, raising questions about the effectiveness of the training. Therefore the AAIB issued the following Safety Recommendation:

2007-006

“It is recommended that the UK CAA and the EASA review the current training requirements for cabin crew members in the use of smoke hoods

to mitigate the communications difficulties which may be encountered and to improve the ability of all crew members to communicate while wearing smoke hoods”.

Due to the locked flight deck door policy, the training in communicating with flight crew should also take into account communication procedures with an inoperative interphone system. Some respondents suggested practicing communication procedures in this situation (see Section 3.6.2):

“While in theory the procedures for communication may seem appropriate, in the event of a real fire if the PA/interphone system were to fail there is no real way of communicating with the flight deck.” (Cabin Crew)

“... we've never practiced communicating on an actual functioning interphone wearing a smokehood. Also, no procedure in place for communicating with cabin crew to flight crew if interphone is not working.” (Cabin Crew)

All of these issues are in line with recommendations made in UK CAA FODCOM 40/2007 (see below).

8.10.3 **Associated Current Regulatory Material**

There are no specific requirements in JAR-OPS 1 for incorporating communication with flight crew into practical fire training.

However, joint training in “aircraft evacuations and other emergencies” is addressed in UK CAA CAP 768 Chapter 29 Paragraph 1.2:

“Operators should make every effort to provide combined training for cabin crew and flight crew. Much of the training that both should receive prior to operating public transport aircraft covers common criteria; i.e. Initial Training, Conversion and Differences Training, etc. Particular emphasis should be placed on the provision of joint practice in aircraft evacuations and other emergencies so that all who are involved learn of the duties other crew members should perform before, during and after evacuation, thereby appreciating the necessity for effective two-way communications in such emergencies.”

Also in UK CAA CAP 768 Chapter 29 Paragraph 1.3:

“When combined training cannot be arranged, an operator's instructors should adopt the role of flight crew or cabin crew, as appropriate. It is important that there is effective liaison between cabin crew and flight crew training departments to promote consistency of drills and procedures. Provision should be made for cabin crew instructors to observe and comment on flight crew training and vice versa.”

There are no specific requirements in JAR-OPS 1 for practicing communication wearing PBE. UK CAA FODCOM 40/2007 on PBE training recommended that:

“3.1 Operators whose crews may need to use PBE should review guidance in their Operations Manual to ensure it includes information about the practical difficulties, which may be experienced when using PBE, particularly barriers to effective communication.

3.2 Operators should ensure that practical training of flight and cabin crew includes the use of communication methods including interphones, passenger announcement systems, and face to face, to demonstrate the potential difficulties in communicating when wearing PBE. The differences between the use of live and dummy units should be emphasised. To ensure a better understanding of both flight and cabin crew actions and procedures, joint practical training should be carried out where possible.”

8.10.4 Foreign Comparable Regulatory Material

Performing communication and coordination procedures is one of the evaluation criteria in TCCA Flight Attendant Training Standard (Reference 10) during Initial (7.8.7) and Annual (7.6.5) Fire Fighting Drill:

- a. Trainee performance shall be observed, rated and debriefed according to:
 - i. Recognition or identification of the problem;
 - ii. Correctly locates the source of the fire (e.g. tactile search, use of crash axe, etc.);
 - iii. **Effective communication/coordination procedures throughout the drill (e.g. notifying fellow crew members of the situation, establish and maintain communication with the flight deck, providing clear, concise information to the pilot-in-command, advice assistance to passengers; etc.);**
 - iv. Responds in a timely manner;
 - v. Correct usage of fire fighting equipment consistent with the type of fire, location of the fire and maximum effective position of the fire extinguisher;
 - vi. Undertake further action as required; and
 - vii. Consequences of error.

TCCA Flight Attendant Training Standard (Reference 10) performance criteria in Initial (7.8.6) and Annual (7.6.4) Fire Fighting Drill also include performing communication and co-ordination procedures.

7.8.6 Fire Fighting - Cabin - Performance Criteria

- a. Each trainee shall demonstrate the ability to carry out fire fighting procedures in a cabin environment as a primary fire fighter and perform the following:
 - i. Recognize that there is a potential fire situation (e.g. smoke detector signal or unusual fumes, odours);
 - ii. Locate the source of fire;
 - iii. **Apply communication/co-ordination procedures;**
 - iv. Select and remove the nearest appropriate fire extinguisher and (if applicable) other fire fighting equipment;
 - v. Inform, assist and control passengers;
 - vi. Operate the extinguisher; and
 - vii. Monitor for re-ignition, and apply post-fire follow-up procedures.

(Performance criteria set out in 7.6.4 is similar to those in 7.8.6.)

TCCA Flight Attendant Training Standard (Reference 10) requires practicing communication while wearing the PBE in equipment practice during Initial (section 7.8.4) and Annual (section 7.6.6) Fire Fighting Drill:

7.8.4 Equipment Practice

- a. Each trainee shall practice the following:
 - i. *Remove from stowage, don and **activate P.B.E. and practice communication;***

7.6.6 Equipment Practice

- b. Each crew member shall demonstrate the ability to use fire fighting equipment not operated in 7.6.3 and perform the following:
 - i. *Remove from stowage, don and **activate P.B.E. and practice communication;***

The US Federal Aviation Regulation for Part 121 Subpart N Section 121.417 (b)(1) (Reference 11) on coordination among crew members in emergency training does not specifically require practical training in communication/coordination between cabin crew and flight crew during an in-flight fire event, or practicing communication whilst wearing PBE.

8.10.5 Possible Change to Current Regulatory Material

Training Affected

Conversion and Differences Training

Recurrent Training (3-yearly)

Proposed Change to Future European Aviation Requirements

It is proposed that consideration be given by EASA to amending Conversion and Differences Training and Recurrent Training to add the following:

An operator shall ensure that each cabin crew member is given realistic and practical training in coordination and communication with the flight crew, both with and without the use of the interphone system, whilst wearing PBE.

Proposed Guidance Material

It is proposed that consideration be given by UK CAA (and/or EASA) to providing guidance material to address practical training in communication/coordination between cabin crew and flight crew during fire and smoke training based on the proposed change to future European aviation requirements above.

8.10.6 Safety, economic and Environmental Impacts

Safety Impact

Both flight crew and cabin crew have experienced difficulty in communicating with each other during an in-flight fire/smoke event. The difficulties were related to the procedure and techniques as well as the use of Protective Breathing Equipment. Since it was observed that practical training did not always include this subject, these difficulties were likely to be experienced by the majority of cabin crew. It is likely that practical training in this subject would have a substantial effect in mitigating these difficulties, and hence improve cabin crew's capability to deal with an in-flight fire/smoke situation and flight crew's decision making process.

Economic Impact

It should be noted that the practical training proposed would be more effective if carried out in a cabin environment, such as in a cabin mock-up. For operators not already using a cabin mock-up for fire or smoke training, it was assessed that the proposed change is likely to incur the following:

- Incremental costs related to the use or acquisition of a cabin mock-up.
- Incremental costs related to the increased instructor man hours.
- Incremental costs related to the increased cabin crew non-revenue time.
- Incremental costs related to flight crew non-revenue time.

- Incremental costs related to the installation of an operational interphone system in cabin mock-up.
- Amendment and change to Training Manuals and Operations Manuals.

It was assumed that the use of PBE during this training would not incur additional cost, since JAR-OPS 1 already requires the use of PBE in smoke training.

There would be costs incurred to the authorities in developing the guidance material and costs related to the regulatory process in amending future European aviation requirements.

Environmental Impact

None identified.

8.10.7 Summary

Findings from the review of current cabin crew fire training programmes, the online survey, the review of non-civil aviation training programmes, and the accident/incident data analysis suggested that practical training in communicating and coordination with flight crew, whilst wearing PBE, is needed. It was also found that practical training in communication/coordination procedures and training in communicating whilst wearing PBE is adequately addressed in Transport Canada Civil Aviation regulatory material. Whilst the economic impacts need to be taken into consideration, addressing this subject in future European aviation requirements will ensure that an improved safety level can be achieved throughout the industry. Detailed guidance material will support the proposed requirements and ensure that operators adopt the best practice in carrying out practical training in communicating and coordinating with flight crew during an in-flight fire/smoke event.

Other Recommendations

Consideration should be given to carrying out research into alternative means of communication methods to accommodate failure of the intercom system.

Consideration should be given to carrying out research into the use of portable communication systems, such as headsets for cabin crew, to improve communication and coordination especially during emergency situations.

8.11 Practical Training in Communication/Coordination with Other Cabin Crew During an In-flight Fire/Smoke Event

8.11.1 Description of Issue

Based on the study, it was evident that consideration needed to be given to cabin crew practical training in communication/coordination with other cabin crew. Ideally, such training would be carried out with and without using an interphone/PA system and involve the use of PBE. Currently, there is no specific requirement on this subject.

8.11.2 Scale of the Issue

The need for practical training in communication/coordination with other cabin crew

The online survey found that problems in communication/coordination amongst cabin crew accounted for 24% of the problems reported by UK respondents who had fought or witnessed an in-flight fire (see Section 3.7). The problems identified were typified by the following responses:

“Crew failed to advise crew at rear of a/c of incident, only time we realised something was wrong was when captain announced diversion.”

"Panic in the team caused communication problems. Not knowing who to inform SCCM OR flight crew"

Although the responses from the online survey indicated that most of the UK respondents were reasonably positive about the appropriateness of procedures for communication and coordination between cabin crew, there were indications that some operators/training organisations did not give sufficient attention to training in communication during practical fire training (see Section 3.6.3):

"The procedures are there however the applied CRM skills are not tested fully in modern realistic aircraft mock-ups. The theory is there but the practical should be given more time to put the theory into practice." (Cabin Crew)

"Maybe would be useful to have a practical training session on this aspect [communication/coordination] of fire fighting. The practical tends to concentrate on just the fire fighting element." (Cabin Crew)

In addition, when considering future threats identified in this study, communications were identified as an area requiring further attention. The increase in the size of aircraft and the resultant increase in number of passengers carried might result in a need for providing cabin crew with more training associated with communications (see Section 5.5.1). This is particularly so on very large aircraft with the increasing number of cabin crew members on board a flight and the resulting complex chain of command.

Practising communication wearing PBE

The comments received from the online survey also highlighted the difficulty in communicating whilst wearing PBE (see Section 3.6.3 and 3.7):

"I think in training we should all try and communicate with a smokehood on, have you ever tried it? It's very difficult to hear and talk, and it's even worse when there's a fire behind you. I tried this in [...] training but not in my current employers training, I think this should be mandatory as it makes you realise how difficult a simple thing can be." (Cabin Crew)

"With everyone on breathing equipment communication will be very difficult if not impossible and this is hardly covered in training." (Instructor)

"I think the difficulties of communicating between each other while all cabin crew are wearing smokehoods is underestimated." (Cabin Crew)

"Very difficult to communicate effectively with anyone when wearing the [Manufacturers Name] smokehood. All parties found this a definite obstacle..." (Cabin Crew)

Although the study found indications of the difficulties of communicating when wearing PBE, there was little in the practical training to address this especially in conjunction with the use of a PA/interphone handset for communication with the flight crew or other cabin crew (see Section 2.4).

Communication while wearing PBE was the main issue in an incident involving a DHC-8-400, which experienced a build-up of smoke in the flight deck and the cabin. According to AAIB Bulletin 4/2007 (EW/C2005/08/10):

"The cabin crew also reported that the smoke hoods had severely hindered communications with the passengers, impeding both hearing and being heard. Because of this, one of the cabin crew had removed her hood shortly before landing.

Checks made during the investigation confirmed that verbal communications while wearing a cabin crew smoke hood were difficult, even when in close proximity to another person. This was due to the combination of a reduction in speech and hearing

volume due to the hood and to interference from relatively loud sounds perceived by the hood wearer, caused by rustling of the hood, the sound of the wearer's breathing and the sound of the wearer's voice."

The AAIB report states that while the cabin crew members had undergone training with smoke hoods, it appeared that this had not fully prepared them for the extent of the associated communication difficulties, raising questions about the effectiveness of the training. Therefore, the AAIB issued the following Safety Recommendation:

2007-006

"It is recommended that the UK CAA and the EASA review the current training requirements for cabin crew members in the use of smoke hoods to mitigate the communications difficulties which may be encountered and to improve the ability of all crew members to communicate while wearing smoke hoods".

As a comparison, during practical fire training observed at the Royal Navy, trainees undertaking the Intermediate Sea Survival Course wore all the protective equipment that they would wear as an emergency team member, including operational breathing apparatus. The fire training scenario required the trainees to communicate and co-ordinate with each other, which enabled them to become familiar with how they hear spoken words, amidst the noise of the fire and water (see Section 4.1.5).

8.11.3 **Associated Current Regulatory Material**

There are no specific requirements in JAR-OPS 1 for incorporating communication and coordination with other cabin crew members into practical fire training.

There are no specific requirements in JAR-OPS 1 for practicing communication whilst wearing PBE. However, UK CAA FODCOM 40/2007 on PBE training recommends that:

3.1 Operators whose crews may need to use PBE should review guidance in their Operations Manual to ensure it includes information about the practical difficulties, which may be experienced when using PBE, particularly barriers to effective communication.

3.2 Operators should ensure that practical training of flight and cabin crew includes the use of communication methods including interphones, passenger announcement systems, and face to face, to demonstrate the potential difficulties in communicating when wearing PBE. The differences between the use of live and dummy units should be emphasised. To ensure a better understanding of both flight and cabin crew actions and procedures, joint practical training should be carried out where possible.

8.11.4 **Foreign Comparable Regulatory Material**

Performing communication and coordination procedures is one of the evaluation criteria in TCCA Flight Attendant Training Standard (Reference 10) during Initial (7.8.7) and Annual (7.6.5) Fire Fighting Drill:

- a. Trainee performance shall be observed, rated and debriefed according to:
 - i. Recognition or identification of the problem;
 - ii. Correctly locates the source of the fire (e.g. tactile search, use of crash axe, etc.);
 - iii. Effective communication/coordination procedures throughout the drill (e.g. notifying fellow crew members of the situation, establish and maintain communication with the flight deck, providing clear, concise information to the pilot-in-command, advice assistance to passengers; etc.);

- iv. Responds in a timely manner;
- v. Correct usage of fire fighting equipment consistent with the type of fire, location of the fire and maximum effective position of the fire extinguisher;
- vi. Undertake further action as required; and
- vii. Consequences of error.

TCCA Flight Attendant Training Standard (Reference 10) performance criteria in Initial (7.8.6) and Annual (7.6.4) Fire Fighting Drill also include performing communication and co-ordination procedures.

7.8.6 Fire Fighting - Cabin - Performance Criteria

- b. Each trainee shall demonstrate the ability to carry out fire fighting procedures in a cabin environment as a primary fire fighter and perform the following:
 - i. Recognize that there is a potential fire situation (e.g. smoke detector signal or unusual fumes, odours);
 - ii. Locate the source of fire;
 - iii. Apply communication/co-ordination procedures;
 - iv. Select and remove the nearest appropriate fire extinguisher and (if applicable) other fire fighting equipment;
 - v. Inform, assist and control passengers;
 - vi. Operate the extinguisher; and
 - vii. Monitor for re-ignition, and apply post-fire follow-up procedures.

(Performance criteria set out in 7.6.4 is similar to those in 7.8.6.)

TCCA Flight Attendant Training Standard (Reference 10) requires practicing communication while wearing the PBE in equipment practice during Initial (section 7.8.4) and Annual (section 7.6.6) Fire Fighting Drill:

7.8.4 Equipment Practice

- c. Each trainee shall practice the following:
 - i. Remove from stowage, don and activate P.B.E. and practice communication;

7.6.6 Equipment Practice

- d. Each crew member shall demonstrate the ability to use fire fighting equipment not operated in 7.6.3 and perform the following:
 - i. Remove from stowage, don and activate P.B.E. and practice communication;

The US Federal Aviation Regulation for Part 121 Subpart N Section 121.417 (b)(1) (Reference 11) on coordination among crew members in emergency training does not specifically require practical training in communication/coordination with other cabin crew members during an in-flight fire event, or practicing communication whilst wearing PBE.

8.11.5 Possible Change to Current Regulatory Material

Training Affected

Conversion and Differences Training

Recurrent Training (3-yearly)

Proposed Change to Future European Aviation Requirements

It is proposed that consideration be given by EASA to amending Conversion and Differences Training and Recurrent Training to add the following:

An operator shall ensure that each cabin crew member is given realistic and practical training in coordination and communication with other cabin crew members which includes the use of communication methods including interphones, passenger announcement systems, and face-to-face communication, whilst wearing PBE.

Proposed Guidance Material

It is proposed that consideration be given by UK CAA (and/or EASA) to providing guidance material to address practical training in communication/coordination with other cabin crew during fire and smoke training based on the proposed change to future European aviation requirements above.

8.11.6 Safety, economic and Environmental Impacts

Safety Impact

Cabin crew have experienced difficulty in communicating with each other during in-flight fire/smoke events. The difficulties were related to the procedure and techniques as well as the use of Protective Breathing Equipment. Since it was observed that practical training did not always include this subject, it is assessed that these difficulties were likely to be experienced by majority of cabin crew. It is likely that practical training in this subject would have a substantial effect in mitigating these difficulties, and hence improve cabin crew's capability to deal with an in-flight fire/smoke situation.

Economic Impact

It should be noted that the practical training proposed would be more effective if carried out in a cabin environment, such as in a cabin mock-up. For operators not already using a cabin mock-up for fire or smoke training, the implementation of the proposed change is likely to incur some additional costs to the operators due to:

- Incremental costs related to the use or acquisition of a cabin mock-up.
- Incremental costs related to the increased instructor man hours.
- Incremental costs related to the increased cabin crew non-revenue time.
- Incremental costs related to the installation of an operational interphone system and PA system in a cabin mock-up.
- Amendment and change to Training Manuals and Operations Manuals.

It was assumed that the use of PBE during this training would not incur additional cost, since JAR-OPS 1 already requires the use of PBE in smoke training.

There would be costs incurred to the authorities in developing the guidance material and costs related to the regulatory process in amending future European aviation requirements.

Environmental Impact

None identified.

8.11.7 Summary

Findings from the review of current cabin crew fire training programmes, the online survey, the review of non-civil aviation training programmes, and the accident/incident data analysis suggested that practical training in communicating and

coordination with other cabin crew members, whilst wearing PBE, is needed. It was also found that practical training in communication/coordination procedures and training in communicating whilst wearing PBE is adequately addressed in Transport Canada Civil Aviation regulatory material. Whilst the economic impacts need to be taken into consideration, addressing this subject in future European aviation requirements will ensure that an improved safety level can be achieved throughout the industry. Detailed guidance material will support the proposed requirements and ensure that operators adopt the best practice in carrying out this practical training.

Other Recommendations

Consideration should be given to carrying out research into the use of portable communication systems, such as headsets for cabin crew, to improve communication and coordination especially during emergencies.

Consideration should also be given to introducing alternative communication procedures, especially when using the public address system, for example by the use of a code word, to alert cabin crew of an in-flight fire/smoke event without causing passengers to panic. This suggestion was made by a respondent of the online survey (see Section 3.13).

8.12 Theoretical Training in Detecting and Locating Source of Smoke and Fire

8.12.1 Description of Issue

The study suggested that theoretical training in detecting and locating the source of smoke/fire was inadequate. There are currently no specific requirements on this subject in JAR-OPS 1.

8.12.2 Scale of the Issue

As described in Section 3.7, difficulties in locating/accessing the source of the smoke/fire accounted for 19% of the problems encountered by crew when dealing with an in-flight smoke/fire event as reported by UK respondents to the online survey. However, there are currently no specific requirements that address this subject during theoretical training in JAR-OPS 1.

Based on the analysis of MOR data, 74% of the problems reported are related to this issue (see Section 5.3) although not all of the problems were related to hidden fires.

As may be seen from Appendix 3, several accidents have highlighted the importance of improving the crew's ability to detect and locate the source of smoke during an in-flight fire occurrence. In the B707 accident in Orly, 11 July 1973, even though the crew took action as soon as smoke was discovered, the intervention was not effective because the origin of the fire could not be located (see Appendix 3):

*"Although the cabin crew quickly used extinguishers, this was not effective because **the source of the fire was never located.**"*

The importance of the skills in identifying smoke/fire and locating its source was evident in the Swissair accident on 2 September 1998 (see Section 5.4.4 and Appendix 3), as indicated by the findings of the accident investigation:

Finding Number 8

*"There was a reliance on sight and smell to detect and differentiate between odour or smoke from different potential sources. **This reliance resulted in the misidentification of the initial odour and smoke as originating from an air conditioning source.**"*

Finding Number 9

“There was no integrated in-flight firefighting plan in place for the accident aircraft, nor was such a plan required by regulation. **Therefore, the aircraft crew did not have procedures or training directing them to aggressively attempt to locate and eliminate the source of the smoke**, and to expedite their preparations for a possible emergency landing. In the absence of such a firefighting plan, they concentrated on preparing the aircraft for the diversion and landing”.

These findings resulted in the TSB making the following Recommendation:

A00-16

“That appropriate regulatory authorities, in conjunction with the aviation community, review the adequacy of in-flight firefighting as a whole, to ensure that aircraft crews are provided with a system whose elements are complementary and optimized to provide the maximum probability of detecting and suppressing any in-flight fire.”

8.12.3 **Associated Current Regulatory Material**

There are no specific requirements addressing theoretical training in detecting and locating the source of smoke/fire in JAR-OPS 1.

8.12.4 **Foreign Comparable Regulatory Material**

TCCA Flight Attendant Training Standard (Reference 10) Section 4.1A Initial and Annual Fire Fighting Training requires cabin crew members to acquire knowledge that can assist in detecting and locating the source of smoke/fire, such as:

- *List the classes of fire which may occur on aircraft: Class A - combustible material fires, Class B - grease/spill fires, Class C - electrical, and Class D - fire involving metals and the possible sources for these fires.*
- *Describe importance of early detection and correct recognition.*
- *Identify the characteristics and behaviour of fire (e.g. what you will see, how the fire will behave) in different cabin environments and fire propagation.*
- *Describe the means of fire/smoke detection (e.g. smell, auditory, visual, tactile).*

US FAA AC 120-80 (Reference 12) provides information on the causes of in-flight fires, indication of hidden fires, the importance of locating the exact source of a fire before applying extinguishing agents, and the best way to locate hot spots. In Chapter 12 (Recommended Training), it states:

- b. Training. Operators should include the following knowledge and skill objectives in their crewmember training programs:
 - (1) Knowledge-based Objectives.
 - (a) In the event of a known or suspected in-flight fire, crewmembers **must know how to take immediate and aggressive action to locate the source of fires.**
 - (b) To assist crewmembers **in locating the source of fires, they must know the various aircraft cabin configurations** (e.g., overhead, sidewall, cheek, and tunnel areas) that they are required to operate.
 - (c) Crewmembers must understand the proper methods and/or techniques to gain access to areas that may support hidden fires and the location of any cabin panels that can be removed without special tools.

- (d) Each flight crewmember must understand the aircraft ventilation systems, including normal and abnormal procedures, with emphasis **on the potential effects of airflow on hidden fires**.
- (e) To enable crewmembers to locate critical equipment components within the fuselage area, operators' manuals should contain a cross section of the aircraft's fuselage showing the location of electrical, fuel, and hydraulic lines.
- (f) Potential indications of hidden fires and the importance of not arbitrarily resetting CBs.

8.12.5 Possible Change to Current Regulatory Material

Training Affected

Conversion and Differences Training

Recurrent Training (3-yearly)

Proposed Change to Future European Aviation Requirements

Although theoretical fire training is only specified in Appendix 1 to JAR-OPS 1.1005 (Initial Training), it is considered essential that this training is carried out during Conversion and Differences Training (due to its aircraft type-specific information) and Recurrent Training (to ensure knowledge retention). Therefore, it is proposed that consideration be given by EASA to amending Conversion and Difference Training and Recurrent Training to add the following subjects:

- The importance of early detection and correct recognition.
- The means of smoke/fire detection (e.g. smell, auditory, visual, and tactile).
- Definition of fire chemistry, including the elements, which must be present for fire to occur (e.g. fuel, heat, oxygen, chemical reactions).
- The classes of fire which may occur on aircraft: combustible material fires, flammable liquid or grease/spill fires, fire involving metals, and electrical fires, and the possible sources of these fires.
- The characteristics and behaviour of fire (e.g. what might be seen, how the fire might behave) in different cabin environments and fire propagation.
- The specific fire risk locations relevant to the aircraft type to be operated, taking into account specific on-board systems and facilities (e.g. In-Flight Entertainment, crew rest areas, etc).
- Knowledge of various areas (e.g., overhead, sidewall, cheek area¹) relevant to the aircraft type to be operated, to assist in locating fire sources, especially relating to the influence of airflows on the smoke travel.
- The aircraft ventilation systems, including normal and abnormal procedures, with emphasis on the potential effects of airflow on hidden fires.

Proposed Guidance Material

It is proposed that consideration be given by UK CAA (and/or EASA) to providing guidance material to address theoretical training in detecting and locating the source of smoke/fire based on the proposed change to future European aviation requirements above.

8.12.6 Safety, economic and Environmental Impacts

Safety Impact

1. Cheek area is the area just below the floor, outboard of the cargo compartment areas. In narrow and widebody aircraft this area houses wire bundles, hydraulic lines, and other electrical components (Reference 12).

Cabin crew have encountered problems in detecting and locating the source of smoke/fire during actual in-flight smoke/fire events. However training on this subject is not specified in JAR-OPS 1 and consequently lack of training on this subject is prevalent across the industry. It is likely that the implementation of training associated with the proposed change would have a significant effect in increasing crew's knowledge of detecting and locating sources of smoke/fire that are not readily visible, and hence reduce the risks associated with such fires to a certain extent.

Economic Impact

The incremental cost to operators associated with the implementation of the change is mostly related to the increased training time and changes to Training Manuals and Operations Manuals.

There would be costs incurred to the authorities in developing the guidance material and costs related to the regulatory process in amending future European aviation requirements.

Environmental Impact

None identified.

8.12.7 Summary

Findings from the review of current cabin crew fire training programmes, the online survey, and the accident/incident data analysis suggested that detecting and locating the source of smoke/fire needs to be addressed in theoretical training. It was also found that this subject is addressed in US FAA and Transport Canada Civil Aviation regulatory material. Whilst the economic impacts need to be taken into consideration, addressing this subject in future European aviation requirements will ensure that an improved safety level can be achieved throughout the industry. Detailed guidance material will support the proposed requirements and ensure that operators adopt the best practice in carrying out theoretical training in detecting and locating the source of smoke/fire.

8.13 Practical Training in Detecting and Locating Smoke/fire

8.13.1 Description of Issue

The study found indications that practical training in detecting and locating the source(s) of smoke/fire was inadequate. There are currently no specific requirements for this subject in JAR-OPS 1.

8.13.2 Scale of the Issue

As described in Section 3.7, difficulty in locating/accessing the source of the fire accounted for 19% of the problems encountered by crew when dealing with an in-flight smoke/fire event as reported by UK respondents to the online survey. However, as indicated by the review of current cabin crew fire training programmes and some comments from the online survey below, some practical fire training did not involve detecting or locating the fire source. Some comments indicated that currently some training facilities were limited in the number of possible fire locations and hence the location of fire would be easily predictable (see Section 3.5.5).

"...at the moment, we all line up and extinguish a fire in an oven - not very realistic at all. Setting it up so we don't know where the fire is going to be or what type it is, who is going to be the first to tackle it etc would make it more realistic." (Cabin Crew)

"... The mock-ups aren't overly realistic with only 1 overhead locker and 1 toilet in the mock-up. It's too predictable" (Instructor)

As a comparison, the trainees at the US training organisation evaluated in this study have to locate the fire out of four possible locations in the cabin mock-up during the full scenario training.

Based on the analysis of MOR data, 74% of the problems reported were related to this issue (see Section 5.3) although not all of the problems were related to hidden fires.

As may be seen from Appendix 3, several accidents have highlighted the importance of improving the crew's ability to detect and locate the source of smoke in an in-flight fire occurrence. In the B707 accident in Orly, 11 July 1973, even though the crew took action as soon as smoke was discovered, the intervention was not effective because the origin of the fire could not be located (see Appendix 3):

*"Although the cabin crew quickly used extinguishers, this was not effective because **the source of the fire was never located.**"*

Following the accident to the MD-99 in Covington, 17 September 1999, the NTSB made the following recommendation:

"The NTSB recommends that the Federal Aviation Administration: Amend 14 Code of Federal Regulations 121.417 to require participation in firefighting drills that involve actual or simulated fires during crewmember Recurrent Training and to require that those drills include **realistic scenarios on recognizing potential signs of, locating, and fighting hidden fires.**" (Rec. A-01-085)

The importance of the skills in identifying smoke/fire and locating its source was evident from the Swissair accident on 2 September 1998 (see Section 5.4.4 and Appendix 3), as indicated by the findings of the accident investigation:

Finding Number 8

"There was a reliance on sight and smell to detect and differentiate between odour or smoke from different potential sources. **This reliance resulted in the misidentification of the initial odour and smoke as originating from an air conditioning source.**"

Finding Number 9

"There was no integrated in-flight firefighting plan in place for the accident aircraft, nor was such a plan required by regulation. **Therefore, the aircraft crew did not have procedures or training directing them to aggressively attempt to locate and eliminate the source of the smoke,** and to expedite their preparations for a possible emergency landing. In the absence of such a firefighting plan, they concentrated on preparing the aircraft for the diversion and landing".

These findings resulted in the TSB making the following Recommendation:

A00-16

"That appropriate regulatory authorities, in conjunction with the aviation community, review the adequacy of in-flight firefighting as a whole, to ensure that aircraft crews are provided with a system whose elements are complementary and optimized to provide the maximum probability of detecting and suppressing any in-flight fire.

8.13.3 Associated Current Regulatory Material

There are no specific requirements or guidelines addressing practical training in detecting and locating the source of smoke/fire in Conversion and Differences Training or Recurrent Training.

8.13.4 Foreign Comparable Regulatory Material

In TCCA Flight Attendant Training Standard (Reference 10) for Initial and Annual Fire Fighting Training, detecting and locating fires are two of the performance criteria for firefighting drills, as follows:

Initial Training:

7.8.6 Fire Fighting - Cabin - Performance Criteria

- c. Each trainee shall demonstrate the ability to carry out fire fighting procedures in a cabin environment as a primary fire fighter and perform the following:
 - i. Recognize that there is a potential fire situation (e.g. smoke detector signal or unusual fumes, odours);
 - ii. Locate the source of fire;

Annual Training:

7.6.4 Cabin Fire Fighting Drill Performance Criteria

- 2) *Each crew member shall participate as a crew member or a passenger in a fire fighting drill in a cabin environment involving at least one crew member and a passenger(s) and perform the following:*
 - i. Recognize that there is a potential fire situation (e.g. smoke detector signal or unusual fumes, odours, etc.);
 - ii. Locate the source of fire;

US FAA AC 120-80 Chapter 12 (Recommended Training) Paragraph b 2) specifies the skills required in locating the source of the fire:

- b. Training. Operators should include the following knowledge and skill objectives in their crewmember training programs:
 - 2) Skill-based Objectives.
 - (a) Cabin crewmembers should practice the procedures and/or techniques associated with:
 - *Aggressively locating the source of the fire*
 - ...
 - *Locating hot spots on interior panels*

8.13.5 Possible Change to Current Regulatory Material

Training Affected

Conversion and Differences Training

Recurrent Training (3-yearly)

Proposed Change

It is proposed that consideration be given by EASA to amending Conversion and Differences Training and Recurrent Training to add the following:

An operator shall ensure that each cabin crew member is given realistic and practical training in detecting and locating various sources of smoke/fire appropriate to the aeroplane operated.

Proposed Guidance Material

It is proposed that consideration be given by UK CAA (and/or EASA) to providing guidance material to address practical training in detecting and locating the source of smoke/fire based on the proposed change to future European aviation requirements above.

8.13.6 **Safety, economic and Environmental Impacts**

Safety Impact

Cabin crew have encountered problems in detecting and locating the source of smoke/fire during actual in-flight fire/smoke events. However training on this subject is not specified in JAR-OPS 1 and consequently lack of training on this subject is prevalent across the industry. It is likely that the implementation of training associated with the proposed change would have a substantial effect in increasing cabin crew's skill in detecting and locating the source of smoke or fire that is not readily visible.

Economic Impact

Some operators and training organisations with the appropriate fire training facilities already incorporate practical training in locating fire during fire scenarios. Others may need to acquire a cabin mock-up, or modify their facilities to be able to accommodate the proposed training. For operators not already using a cabin mock-up for smoke/fire training, it was assessed that the proposed change would probably incur the following:

- Incremental costs related to the acquisition of a cabin mock-up with multiple fire sources (a two-door cabin mock-up without high fidelity doors).
- Incremental costs related to the increased instructor man hours.
- Incremental costs related to the increased cabin crew non-revenue time.
- Amendment and change to Training Manuals and Operations Manuals.

There would be costs incurred to the authorities in developing the guidance material and costs related to the regulatory process in amending future European aviation requirements.

Environmental Impact

None identified.

8.13.7 **Summary**

Findings from the review of current cabin crew fire training programmes, the online survey, and the accident/incident data analysis suggested that detecting and locating the source of smoke/fire needs to be addressed in practical training. It was also found that this subject is addressed in US FAA and Transport Canada Civil Aviation regulatory material. Whilst the economic impacts need to be taken into consideration, addressing this subject in future European aviation requirements will ensure that an improved safety level can be achieved throughout the industry. Detailed guidance material will support the proposed requirements and ensure that operators adopt the best practice in carrying out practical training in detecting and locating the source of smoke/fire.

Other Recommendations

Consideration should be given to investigating the feasibility of using complementary tools such as thermal imaging cameras to assist crew in detecting and locating fire or hotspots.

8.14 Theoretical and Practical Training for Dealing with Hidden Fires

8.14.1 Description of Issue

The study found indications that the level of training for dealing with hidden fires carried out by some operators/training organisations was not sufficient. It was also identified that the requirements of JAR-OPS 1 do not specifically address training for dealing with hidden fires.

8.14.2 Scale of the Issue

In Section 3.7, it was revealed that difficulty in locating/accessing the source of fire accounted for 19% of the problems encountered when dealing with in-flight fire/smoke events reported by UK respondents to the online survey:

"I knew it was coming from behind the cradle form-work, but could not immediately work out how to dismantle this to check that the fire had been extinguished by the BCF shot, from the Cabin staff involved. I did not use the axe/jemmy, as I knew that there were a multitude of wires behind there." (Cabin Crew)

"Finding the source of the fire was not easy as it was behind a panel. We had to 'feel' the panels on the aircraft and behind the hot one was the fire." (Cabin Crew)

Based on the analysis of MOR data, 74% of the problems reported were related to locating and accessing fire (see Section 5.3), although not all of the problems were related to hidden fires. Although the MOR analysis did not find hidden fires to be a high frequency occurrence, the potential severity of such an occurrence is possibly the highest of all in-flight fire types. Most of the recommendations issued by accident investigation authorities that were related to in-flight fires were based on fatal accidents involving hidden fires (see Appendix 3).

The online survey found that the rating averages of the responses to the adequacy of training for "fire behind panels" did not demonstrate a particularly "strong" overall positive attitude, which was probably due to the differences in training practices amongst operators/training organisations (see Section 3.4.1). Comments received suggested that conducting appropriate practical training for this type of fire threat could increase crew confidence:

"In 11 years I have never done any practical exercise which involved pulling out a panel with a jemmy. Practicals seem to centre around toilet & oven fires. I think our practical training for these types of fires is good but fires behind panels are covered theoretically only." (Cabin Crew)

"The training only covers the topic of fighting fires behind panels, it would be good to have a practical exercise, as this would then also show crew how to safely use a crash axe too!" (Cabin Crew)

"I think the practical training should be more extensive. It is true that we get told by the trainers and it's written in our manuals about extinguishing fires behind panels etc but we should be given opportunity to use the axe for instance (behind panels)." (Cabin Crew)

Additionally, there appeared to be a lack of training with regard to the risks involved in using the crash axe. The comments received from the online survey suggested that it would be valuable to improve cabin crew knowledge on the systems contained behind aircraft panels (see Section 3.4.1).

"During training crew are not taught enough about what is behind each panel, which could in turn lead to more problems if the wrong panel or piece of equipment is used in the wrong area." (Cabin Crew)

"There is only a weak point where I could do with a bit more training, which is smoke/fire behind cabin panels. I really don't know what is there behind those panels. If there was a fire/smoke behind those panels and I couldn't put it off following the standard procedures in the manuals, I wouldn't know what to do." (Cabin Crew)

Some respondents submitted a few suggestions on improving the training on this subject (see Section 3.13):

"Our discussion in CRM involves photos of interior panels being removed, of wiring and cable runs behind panels, and how to remove panels and/or use the fire axe effectively to gain access." (CRMI Training/Standards Pilot)

"The part of the fire training that we conduct is onboard the aircraft this gives them a better understanding of the actual locations of electrical equipment, circuit breakers, where the bundles of wires are located behind bulkheads and panels, but limits our ability to conduct realistic fire fighting training." (Instructor)

The importance of training crew to identify smoke/fire and locate its source was evident in the Swissair accident on 2 September 1998 (see Section 5.4.4 and Appendix 3), as indicated by the findings of the accident investigation:

Finding Number 8

"There was a reliance on sight and smell to detect and differentiate between odour or smoke from different potential sources. This reliance resulted in the misidentification of the initial odour and smoke as originating from an air conditioning source".

Finding Number 9

"There was no integrated in-flight firefighting plan in place for the accident aircraft, nor was such a plan required by regulation. **Therefore, the aircraft crew did not have procedures or training directing them to aggressively attempt to locate and eliminate the source of the smoke**, and to expedite their preparations for a possible emergency landing. In the absence of such a firefighting plan, they concentrated on preparing the aircraft for the diversion and landing".

Following the accident to the MD-99 in Covington, 17 September 1999, the NTSB made the following recommendations:

A-01-083

"The NTSB recommends that the FAA: Issue an advisory circular (AC) that describes the need for crewmembers to take immediate and aggressive action in response to signs of an in-flight fire. **The AC should stress that fires often are hidden behind interior panels and therefore may require a crewmember to remove or otherwise gain access to the area behind interior panels in order to effectively apply extinguishing agents to the source of the fire**".

A-01-084

“The NTSB recommends that the FAA: Require principal operations inspectors to ensure that the contents of the advisory circular (recommended in A-01-083) are incorporated into crewmember training programs.

A-01-085

“The NTSB recommends that the Federal Aviation Administration: Amend 14 Code of Federal Regulations 121.417 to require participation in firefighting drills that involve actual or simulated fires during crewmember Recurrent Training and to require that those drills include realistic scenarios on recognizing potential signs of, locating, and fighting hidden fires”.

During an in-flight fire occurrence on an American Airlines DC-9 on 29 November 2000, a flight attendant, working with a passenger, successfully extinguished the fire by cutting a hole in the overhead panel and applying extinguishing agent. The NTSB commented that “...*Although this action was successful, the Board notes that the flight attendant took the action on her own initiative, not because she was trained to do so...*”.

8.14.3 **Associated Current Regulatory Material**

There are no specific requirements or guidelines addressing theoretical or practical training for hidden fires in Conversion and Differences Training or Recurrent Training. There is however a requirement for training in the use of crash axes and/or crowbars.

CONVERSION AND DIFFERENCES TRAINING – Appendix 1 to JAR-OPS 1.1010

(h) Safety equipment. An operator shall ensure that each cabin crew member is given realistic training on, and demonstration of, the location and use of safety equipment including the following:

(7) Fire axe or crow-bar;

UK CAA CAP 768 cited the FAA Advisory Circular 120-80 on In-flight Fires which addresses the important issues relevant to hidden fires.

8.14.4 **Foreign Comparable Regulatory Material**

In response to NTSB recommendations, the US FAA issued Advisory Circular AC No. 120-80 on In-flight Fires (Reference 12). This Advisory Circular:

- Discusses the dangers of in-flight fires, with particular emphasis on hidden fires that may not be visible or easily accessed by the crew. It discusses the importance of recognizing and quickly assessing the conditions that may be associated with hidden fires and the importance of taking immediate action to gain access to fires that are located behind interior panels.
- Provides guidance on how to deal with in-flight fires, emphasizing the importance of crew members taking immediate and aggressive action in response to signs of an in-flight fire while stressing the effectiveness of Halon extinguishing agents.
- Discusses the importance of appropriate crew member training in dealing with hidden fires, the effective application of fire extinguishing agents behind interior panels, and the urgency of the crew’s action in dealing with such fires.

8.14.5 Possible Change to Current Regulatory Material

Training Affected

Conversion and Differences Training

Recurrent Training (3-yearly)

Proposed Change to Future European Aviation Requirements

It is proposed that consideration be given by EASA to amending Conversion and Differences Training and Recurrent Training to add the following:

An operator shall ensure that each cabin crew member is given realistic and practical training in dealing with hidden fires, including the use of crash axe or crowbar, and access to a fire source behind cabin sidewall and ceiling panels. Training should also be provided on the critical aircraft systems behind panels and smoke travel from the fire source.

Proposed Guidance Material

It is proposed that consideration be given by UK CAA (and/or EASA) to providing guidance material to address training in dealing with hidden fires including the use of crash axe or crowbar, access to a fire source behind cabin sidewall and ceiling panels, and the critical aircraft systems behind panels and smoke travel from the fire source.

8.14.6 Safety, economic and Environmental Impacts

Safety Impact

Despite its relatively low frequency of occurrence, a hidden fire event is potentially one of the more severe in-flight fire threats that can be catastrophic if not dealt with promptly and appropriately. However, as the findings of the study suggested, theoretical and practical training in dealing with hidden fires appeared to be inadequate in the training provided by the majority of operators and training organisations. The implementation of training associated with the proposed change is likely to have a substantial effect in improving cabin crew knowledge and skill in dealing with hidden fires and hence improving the safety level in flight operations of the majority of operators.

Economic Impact

The implementation of the proposed change is likely to incur some additional costs to the operator due to:

- The installation of additional training equipment, in this case installation of mock panels for practicing locating hot spots and removing panels.
- The increased instructor man hours.
- The increased cabin crew non-revenue time.
- Amendments to Training and Operations manuals.

There would be costs incurred to the authorities in developing the guidance material and costs related to the regulatory process in amending future European aviation requirements.

Environmental Impact

None identified.

8.14.7 **Summary**

Findings from the review of current cabin crew fire training programmes, the online survey, and the accident/incident data analysis suggested that specific training requirements and guidance material for dealing with hidden fires need to be considered. It was also found that this subject is addressed in detail in US FAA regulatory material. Whilst the economic impacts need to be taken into consideration, addressing this subject in future European aviation requirements will ensure that an improved safety level can be achieved throughout the industry. Detailed guidance material will support the proposed requirements and ensure that operators adopt the best practice in carrying out theoretical and practical training in dealing with hidden fires.

Other Recommendations

Consideration should be given to investigating the feasibility of implementation of procedures or aircraft modifications that will provide the most effective means for crew members to gain access to areas behind interior panels for the purpose of applying extinguishing agent to hidden fires.

Consideration should be given to investigate the feasibility of using complementary tools such as thermal imaging cameras to assist crew in detecting and locating fire or hotspots.

8.15 **Practical Training in Removing Firefighting Equipment from Stowage during Fire and Smoke Training**

8.15.1 **Description of Issue**

The study found that that some cabin crew have experienced difficulties in removing firefighting equipment (particularly fire extinguishers) from stowage during an in-flight fire/smoke event, which could have caused a delay in dealing with the fire. This was supported by the comments received from the online survey that suggested removal of firefighting equipment from its stowage be included ideally as part of practical fire training.

8.15.2 **Scale of the Issue**

JAR-OPS 1 requires the removal of all safety equipment during Conversion and Differences Training. Most operators visited in the review of current cabin crew fire training programmes stated that this training was achieved during an aircraft visit, not as part of the practical fire training (see Section 2.2.1). As a comparison, removal of firefighting equipment from its stowage is included in the cabin crew practical fire training scenario provided by a US training organisation evaluated in this task (see Section 2.2.1). It was also observed that practical fire training at the Royal Navy involved removing equipment (handheld fire extinguisher, protective breathing equipment, and fire hose) from a generic stowage in the Fire Fighting Training Unit (simulator) in a smoke-filled environment (see Section 4.1.5).

There are no requirements in JAR-OPS 1 specifying that removal of firefighting equipment be carried out during Recurrent Training. This means that a cabin crew member may go many years without removing, for example, a fire extinguisher from its stowage and this unfamiliarity might cause a delay in the access to, and removal of, the equipment. Additionally, changes to stowage locations and stowage restraints are not necessarily addressed practically in Conversion and Differences Training or during Recurrent Training.

Problems in accessing/removing firefighting equipment from the stowage accounted for 9% of the problems encountered when dealing with in-flight fire/smoke reported in the survey by UK respondents (see Section 3.7).

"Some of our equipment is stowed in ridiculous places and access can and will be difficult in a serious onboard fire."

"Very difficult to remove Halon extinguisher from 'doghouse' stowage"

The analysis of MOR data during the period 2002-2006 found one reported problem relevant to this issue (see Section 5.3.1):

Smoke from galley oven, during the cruise. BCF used. Cause found to be charring/burning of cardboard packaging used for children's meals. **Difficulty found in unclipping the BCF extinguisher**, due to the clamp being situated deep inside a box behind passenger seat row.

Some respondents to the online survey indicated that practical training in removing firefighting equipment from the actual stowage would be beneficial (see Section 3.5.5):

"...more practical work with actual stowage on a/c would be beneficial." (Cabin Crew)

"I have always stated that it would be useful to retrain people on how to actually release the equipment from its stowages, as we only view the all of our safety equipment on each security/safety check. Removing it is a totally different matter and each piece of equipment has a different means by which it is stowed. As we don't EVER practice removing equipment from stowages - it could be a time hindrance if there was a need to do it in a hurry and possibly in a smoke filled cabin..." (Cabin Crew)

Other comments suggested the inclusion of the removal of firefighting equipment from its stowage, in locations appropriate to the aircraft operated, during practical fire training (see Section 3.5.4):

"The instructors also shove some BCF's on the last row of seats, which is ridiculous as that's not where they are located onboard our a/c. They should be in the appropriate stowage so I can see how easy/hard it will be to find it in a smoke filled environment." (Instructor/Senior Cabin Crew)

"The simulator that we use in training is no where near like any aircraft that we fly on, i.e. the layout yes but the equipment should be placed exactly where it is as if it's a real scenario, therefore crew would appreciate removing equipment from stowages and tackling fires..." (Cabin Crew)

8.15.3 Associated Current Regulatory Material

Training in removal of firefighting equipment is only required in Conversion and Differences Training:

CONVERSION AND DIFFERENCES TRAINING – Appendix 1 to JAR-OPS 1.1010

(a) General. An operator shall ensure that:

(2) During Conversion and Differences Training, training is given on the **location, removal and use of all safety and survival equipment** carried on the aeroplane, as well as all normal and emergency procedures related to the aeroplane type, variant and configuration to be operated.

- (h) Safety equipment. An operator shall ensure that each cabin crew member is given realistic training on, and demonstration of, the **location and use of safety equipment...**

8.15.4 Foreign Comparable Regulatory Material

TCCA Flight Attendant Training Standard ((Reference 10)) for equipment practice in Initial (7.8.4) and Annual (7.6.6) Fire Fighting Drill requires cabin crew members to:

- i. **Remove from stowage**, don and activate protective breathing equipment and practice communications;
- ii. **Remove from stowage** and operate each type of fire extinguisher and associated attachments (e.g. extinguisher fitted with hose attachment, extension/wand, etc.);

TCCA's cabin fire fighting drill performance criteria for Initial (Chapter 7.8.6) and Annual (Chapter 7.6.4) also includes training in the removal of the appropriate fire extinguisher and other firefighting equipment:

7.8.6 Fire Fighting - Cabin - Performance Criteria

- d. Each trainee shall demonstrate the ability to carry out fire fighting procedures **in a cabin environment** as a primary fire fighter and perform the following:
 - i. Recognize that there is a potential fire situation (e.g. smoke detector signal or unusual fumes, odours);
 - ii. Locate the source of fire;
 - iii. Apply communication/co-ordination procedures;
 - iv. Select and **remove** the nearest appropriate fire extinguisher and (if applicable) other fire fighting equipment;
 - v. Inform, assist and control passengers;
 - vi. Operate the extinguisher; and
 - vii. Monitor for re-ignition, and apply post-fire follow-up procedures.

(Similar to chapter 7.6.4.)

Additionally, TCCA's cabin fire fighting drill equipment criteria for Initial (Chapter 7.8.3 (b)) and Annual (Chapter 7.6.3 (b)) also states that:

*... Fire fighting equipment and the **brackets used for restraint shall be identical to those installed in the aircraft** with respect to weight, dimensions, controls, types and operations...*

This is in line with US FAA General Technical Administration Volume 3 Chapter 23 Section 6 (Reference 13) Paragraph 3-1858 C 3):

Crewmembers should **remove each type of fire extinguisher from its brackets. The brackets should be the same as those on the airplane.**

8.15.5 Possible Change to Current Regulatory Material

Training Affected

Conversion and Differences Training

Recurrent Training (3-yearly)

Proposed Change to Future European Aviation Requirements

It is proposed that consideration be given by EASA to amending Conversion and Differences Training and Recurrent Training to add the following:

An operator should ensure that each cabin crew member removes each item of firefighting equipment from its stowage during fire and smoke training and that the restraint stowage brackets be identical to those installed in the aeroplane in respect of weight, dimensions, controls, types and operation.

Proposed Guidance Material

It is proposed that consideration be given by UK CAA (and/or EASA) to providing guidance material to address the provision of training in removal of firefighting equipment from its stowage during fire and smoke training based on the proposed change to future European aviation requirements above.

8.15.6 Safety, economic and Environmental Impacts

Safety Impacts

It was observed that lack of training in removal of firefighting equipment from a representative stowage during fire and smoke training was prevalent in the majority of operators/training organisations. This could be one of the factors causing the difficulty experienced by cabin crew during actual in-flight fire/smoke incidents. It is likely that the training associated with the proposed change would have a substantial effect in mitigating the difficulty in removing firefighting equipment during an in-flight fire/smoke event.

Economic Impacts

Ideally, the training stowage should be installed in a cabin mock-up/simulator at locations that are representative of the aircraft operated. However, due to the generic nature of cabin mock-ups/simulators, it is understood that this may not be feasible for many operators/training organisations. Therefore, training on locations of firefighting/protective equipment may be carried out separately in accordance with Appendix 1 to JAR-OPS 1.1010 (a)(2) and (h) and Appendix 1 to JAR-OPS 1.1015 (b)(4).

The implementation of the proposed change is likely to incur some additional costs to the operators due to:

- Incremental costs related to the increased instructor man hours due to additional practical training exercises.
- Incremental costs related to the increased cabin crew non-revenue time due to additional practical training exercises.
- Incremental costs related to the required installation of training stowages (i.e. doghouse stowage and brackets) representative of those installed on the aircraft.
- Amendment and change to Training Manuals and Operations Manuals.

There would be costs incurred to the authorities in developing the guidance material and costs related to the regulatory process in amending future European aviation requirements.

Environmental Impacts

None identified.

8.15.7 Summary

Findings from the review of current cabin crew fire training programmes, the online survey, the review of non-civil aviation training programmes, and the accident/incident data analysis suggested that consideration needs to be given to the issue of removal of firefighting equipment, from representative stowage, during fire and smoke training. It was also found that this subject is addressed in US FAA and Transport Canada Civil Aviation regulatory material. Whilst the economic impacts need to be taken into consideration, addressing this subject in future European aviation requirements will ensure that an improved safety level can be achieved throughout the industry. Detailed guidance material will support the proposed requirements and ensure that operators adopt the best practice in carrying out practical training in removing firefighting equipment from its stowage.

8.16 Practical Training in Removing Protective Breathing Equipment from Packaging

8.16.1 Description of Issue

The study found that removal of PBE from its packaging has presented difficulties to cabin crew during in-flight fire/smoke events. However, JAR-OPS 1 requirements and training programmes do not specifically address this issue in practical fire and smoke training. Consideration should be given to amending the requirements to include removing the PBE from packaging during practical training.

8.16.2 Scale of the Issue

PBE carried on an aeroplane is usually stowed inside a vacuum-packed container, which is stowed in a rigid or semi-rigid box or container. To access the PBE, the box or container has to be opened, the vacuum pack removed, the vacuum pack opened and the PBE unit shaken out so it is ready for use. The review of current cabin crew fire training programmes found that cabin crew rarely had any practical experience of this process. The practical fire training only involves donning of the PBE (see Section 2.2.4).

15% of the problems encountered when dealing with in-flight fire/smoke occurrences reported in the survey by UK respondents were related to using PBE. Approximately 58% of the reported PBE problems were related to removing it from its packaging (see Section 3.7):

"The smokehood took a long time to unfold from the packaging and was very stiff." (Cabin Crew)

The survey found that some respondents were concerned that they only practiced donning the PBE, not the entire process involved with its use (see Section 3.5.3):

"... Make us open a smokehood box and take it out and put it on at least once during our career so we can see how difficult it is to use onboard." (Cabin Crew)

"The physical opening and operation of the smokehoods in my airline could be improved, as they are already set up in the training centre." (Cabin Crew)

"Insufficient training and practice given to removing PBE from stowage removing PBE from its packaging..." (Cabin Crew)

As part of crew fire training at the Royal Navy, the fire scenario training included removing the evacuation PBE from its stowage and container/packaging and donning it in a simulated smoke-filled environment (see Section 4.1.5).

8.16.3 **Associated Current Regulatory Material**

The requirements for PBE training in Conversion and Differences Training and Recurrent Training in JAR-OPS 1 do not specifically require training in removing the PBE from its packaging:

CONVERSION AND DIFFERENCES TRAINING – Appendix 1 to JAR-OPS 1.1010

(b) Fire and smoke training. An operator shall ensure that:

- (1) Each cabin crew member is given realistic and practical training in the use of all fire fighting equipment including protective clothing representative of that carried in the aeroplane. This training must include:

- (ii) **The donning and use of protective breathing equipment** by each cabin crew member in an enclosed, simulated smoke-filled environment.

RECURRENT TRAINING – Appendix 1 to JAR-OPS 1.1015

(c) An operator shall ensure that, at intervals not exceeding three years, Recurrent Training also includes;

- (3) Each cabin crew member being given realistic and practical training in the use of all fire-fighting equipment, including protective clothing, representative of that carried in the aeroplane. This training must include:

- (ii) **The donning and use of protective breathing equipment** by each cabin crew member in an enclosed, simulated smoke-filled environment.

8.16.4 **Foreign Comparable Regulatory Material**

TCCA Flight Attendant Training Standard (Reference 10) requires removal of PBE from stowage during equipment practice in Initial (section 7.8.4) and Annual (section 7.6.6) Fire Fighting Drill, but does not implicitly require removal of PBE from packaging:

7.8.4 Equipment Practice

e. Each trainee shall practice the following:

- i. Remove from stowage, don and activate P.B.E. and practice communication;***

7.6.6 Equipment Practice

f. Each crew member shall demonstrate the ability to use fire fighting equipment not operated in 7.6.3 and perform the following:

- i. Remove from stowage, don and activate P.B.E. and practice communication;***

The requirement for crew member emergency training in US Federal Aviation Regulation Section 121.417 (Reference 11) does not specifically require training in removal of PBE from its container or packaging. However, the US FAA General Technical Administration Volume 3 Chapter 23 Section 6 (Reference 13) Paragraph 3-1858 D states that:

PBE training should include:

- 2) **Removing PBE from its stowage area and container/pouch.** Flight attendants and pilots have been surprised by the forces necessary to remove PBE from the pouches used in training. The forces necessary to open the actual PBE storage units on aircraft was greater than the forces necessary to open the pouches used in training. Therefore, it is important that the pouches used to store the training PBE accurately replicate the actual forces necessary to open the storage units on aircraft. For example, if the PBE on the aircraft is kept in stapled pouches, which could require as much as 28 pounds of force to open, the forces necessary to open these pouches should be simulated when opening the "training pouch."
- 3) Donning the PBE, activating it, and other actions necessary to use the installed equipment.

8.16.5 **Possible Change to Current Regulatory Material**

Training Affected

Conversion and Differences Training

Recurrent Training (3-yearly)

Proposed Change to Future European Aviation Requirements

It is proposed that consideration be given by EASA to amending Conversion and Differences Training requirements set out in Appendix 1 to JAR-OPS 1.1010 (b)(1)(ii) and Recurrent Training requirements set out in Appendix 1 to JAR-OPS 1.1015 (c)(3)(ii) as follows:

- (ii) The donning and use of protective breathing equipment by each cabin crew member in an enclosed, simulated smoke-filled environment, including the opening and removing of PBE from its container and packaging. "Training packaging" may be used as long as it accurately replicates the forces and techniques necessary to open and remove the actual PBE from its packaging.

Proposed Guidance Material

It is proposed that consideration be given by UK CAA (and/or EASA) to providing guidance material to address training in removal of PBE from packaging during fire and smoke training.

8.16.6 **Safety, economic and Environmental Impacts**

Safety Impact

Cabin crew have experienced difficulty in opening and removing PBE from its packaging during actual in-flight fire/smoke events and it is likely that this problem will be experienced by more cabin crew in the future since this subject is inadequately addressed in the current practice. It is likely that the implementation of training associated with the proposed change would have a substantial effect in mitigating the difficulty in removing PBE from its packaging during a fire/smoke event, enabling cabin crew to respond to the fire in a timely manner.

Economic Impact

The implementation of the proposed change is likely to incur some additional costs to the operators due to:

- Incremental costs related to the increased instructor man hours.
- Incremental costs related to the increased cabin crew non-revenue time.
- Incremental costs related to the research, design, and manufacture, or the purchase of "training packaging". It should be noted that the "training packaging" currently used by a US operator is a reusable pouch (made in-house) using Velcro to simulate the forces to open the packaging. Provided that such a training aid can offer the necessary realism required for this training, the costs related to the use of "training packaging" could be minimised.
- Amendment and change to Training Manuals and Operations Manuals.

There would be costs incurred to the authorities in developing the guidance material and costs related to the regulatory process in amending future European aviation requirements.

Environmental Impact

There may be waste products involved if using disposable "training packaging". Operators and training organisations should be encouraged to minimise this environmental impact, for example by using recyclable or reusable products.

8.16.7 Summary

Findings from the review of current cabin crew fire training programmes, the online survey, and the review of non-civil aviation training programmes suggested that removing PBE from its packaging needs to be addressed in practical training. Whilst the economic impacts need to be taken into consideration, addressing this subject in future European aviation requirements will ensure that an improved safety level can be achieved throughout the industry. Detailed guidance material will support the proposed requirements and ensure that operators adopt the best practice in carrying out practical training on this subject.

Other Recommendations

Consideration should also be given to investigating the feasibility of developing PBE containers and packaging so that they are easier to open; hence reducing the possible delay in dealing with an in-flight fire.

8.17 Theoretical and Practical Training in the Management of Passengers during In-Flight Fire/Smoke Events

8.17.1 Description of Issue

The study found that training for the management of passengers during in-flight fire/smoke events might not be sufficient, and that JAR-OPS 1 requirements do not specifically address this subject.

8.17.2 Scale of the Issue

The review of current cabin crew fire training programmes found that passenger management during an in-flight fire/smoke event was primarily covered during theoretical training. The online survey found that there appeared to be a polarity in the distribution of responses to the statement "The training for the management of passengers in the event of in-flight fire is adequate", which was more apparent in the group with in-flight fire experience. This might be caused by different training practices amongst operators/training organisations, or a different perception of how

"adequate" the training for passenger management could be, considering the many variables involved (see Section 3.4.4).

Most UK respondents who answered "Disagree" or "Strongly disagree" stated that they never received any training in passenger management, or that the training was not sufficient:

"Practical training involving a cabin with passenger reactions and having to properly move passengers and equipment would be useful..." (Cabin Crew/ Line Trainer)

"... re. management of passengers, our procedures has one crew member dedicated to this amongst other responsibilities. However the actual detail in training of how to manage passengers in a fire situation is very vague. It is assumed you would use your common sense, by asking them to 'move away from the area', 'put heads down low', 'breathe through seat covers', etc" (Cabin Crew)

"There should be more time spent on passenger control during an in-flight fire. More background knowledge could be transmitted regarding crowd panic and how to deal with it." (Cabin Crew)

The survey also found that 7% of the problems reported by UK respondents were related to passenger management (see Section 3.7):

"Passengers panicked and I had no idea how to calm situation - they were all standing up shouting..."

"Cabin crew not capable of demonstrating crowd control on worried passengers."

In addition, when considering future threats identified in the incident/accident data analysis, passenger management was identified as an area requiring further attention, given that increases in the size of aircraft and the resultant increase in number of passengers carried may result in a need for further attention being given to crew training associated with passenger management.

As a comparison, the US training organisation evaluated in this study carries out training in passenger handling in the classroom (theoretical) and in the "scenario trainer" to practice the correct commands for firefighting as well as those needed for an ensuing landing with evacuation. These commands and procedures are also practiced in the "fire trainer".

8.17.3 **Associated Current Regulatory Material**

Passenger handling/crowd control training requirements in Appendix 1 to JAR-OPS 1.1005 (f) (Initial Training) and Appendix 1 to JAR-OPS 1.1010 (f) (Conversion and Differences Training) do not specify training in passenger handling/crowd control during an in-flight fire event. Appendix 1 to JAR-OPS 1.1015 (Recurrent Training) does not specifically address training in passenger handling/crowd control except for evacuation procedures.

8.17.4 **Foreign Comparable Regulatory Material**

TCCA Flight Attendant Training Standard (Reference 10) for Initial and Annual Fire Fighting Training requires cabin crew members to:

4.1C.2 Describe the techniques and procedures for fighting these fires including finding the source of the fire, type of extinguisher to use, additional fire fighting equipment needed, complications to fighting these types of fires, limitations to

fighting this type of fire, post-fire procedures, crew communication and coordination procedures, and **passenger-handling**.

4.1C.3 Identify ways to maintain breathing comfort for cabin occupants.

TCCA Flight Attendant Training Standard (Reference 10) for equipment practice for Initial (7.8.4) and Annual (7.6.6) Fire Fighting Drill requires cabin crew to:

iii. Initiate fire fighting procedures including intervention involving one or more crew members or a passenger.

Informing, assisting and controlling passengers are also a few of the performance criteria in TCCA Flight Attendant Training Standard (Reference 10) for Initial (7.8.6) and Annual (7.6.4) Fire Fighting Drill:

7.8.6 Fire Fighting - Cabin - Performance Criteria

- e. Each trainee shall demonstrate the ability to carry out fire fighting procedures in a cabin environment as a primary fire fighter and perform the following:
 - i. Recognize that there is a potential fire situation (e.g. smoke detector signal or unusual fumes, odours);
 - ii. Locate the source of fire;
 - iii. Apply communication/co-ordination procedures;
 - iv. Select and remove the nearest appropriate fire extinguisher and (if applicable) other fire fighting equipment;
 - v. Inform, assist and control passengers;
 - vi. Operate the extinguisher; and
 - vii. Monitor for re-ignition, and apply post-fire follow-up procedures.

7.6.4 Cabin Fire Fighting Drill Performance Criteria

- 3) *Each crew member shall participate as a crew member or a passenger in a fire fighting drill in a cabin environment involving at least one crew member and a passenger(s) and perform the following:*
 - i. Recognize that there is a potential fire situation (e.g. smoke detector signal or unusual fumes, odours, etc.);
 - ii. Locate the source of fire;
 - iii. Apply communication and co-ordination procedures;
 - iv. Select, remove and operate the nearest appropriate fire extinguisher and other fire fighting equipment;
 - v. Control of passengers; and
 - vi. Monitor for re-ignition, and apply post-fire follow-up procedures

8.17.5 **Possible Change to Current Regulatory Material**

Training Affected

Conversion and Differences Training

Recurrent Training (3-yearly)

Proposed Change to Future European Aviation Requirements

It is proposed that consideration be given by EASA to amending Conversion and Differences Training and Recurrent Training to add the following:

An operator shall ensure that each cabin crew member is given realistic theoretical and practical training in passenger management in in-flight fire and smoke situations, including instructions for maintaining comfortable breathing for cabin occupants.

Proposed Guidance Material

It is proposed that consideration be given by UK CAA (and/or EASA) to providing guidance material to address theoretical and practical training in management of passengers during an in-flight fire/smoke event, including instructions for maintaining comfortable breathing for cabin occupants.

8.17.6 **Safety, Economic and Environmental Impacts**

Safety Impact

Since lack of training in this subject was observed to be prevalent amongst the majority of operators/training organisations, it is likely that the proposed training requirement would have a substantial effect in improving passenger management skills during in-flight fire/smoke events for the majority of cabin crew. Passenger survivability during in-flight fire/smoke events might also be improved.

Economic Impact

The implementation of the proposed change is likely to incur some additional costs to the operator due to:

- Incremental costs related to the increased instructor man hours.
- Incremental costs related to the increased cabin crew non-revenue time.
- Amendment to Training Manuals and Operations Manuals.

There would be costs incurred to the authorities in developing the guidance material and costs related to the regulatory process in amending future European aviation requirements.

Environmental Impact

None identified.

8.17.7 **Summary**

Findings from the review of current cabin crew fire training programmes, the online survey, and the identification of future threats suggested that specific training requirements and guidance material for management of passengers during in-flight fire/smoke events needs to be addressed. It was also found that this subject is addressed in Transport Canada Civil Aviation minimum firefighting training requirements. Whilst the economic impacts need to be taken into consideration, addressing this subject in future European aviation requirements will ensure that an improved safety level can be achieved throughout the industry. Detailed guidance material will support the proposed requirements and ensure that operators adopt the best practice in carrying out theoretical and practical training in management of passengers during an in-flight fire/smoke event.

8.18 Requirement for Fire Scenarios Addressed in Training

8.18.1 Description of Issue

JAR-OPS 1 requirements do not specify the types of in-flight fires that should be addressed in cabin crew fire training. The study found that theoretical training did not always cover all fire types relevant to the aircraft operated and cabin crew practical training experience was limited to a very few types of fire. There was also the need to emphasise during training those fire threats requiring specific procedures such as electrical/IFE system fires, PED/lithium battery fires, multiple fires, and flight deck fires.

Whilst it would not be feasible for cabin crew practical training to include all fire scenarios, there should at least be a requirement for all types of fire threats, appropriate to the aircraft operated, to be addressed in theoretical training, ideally by demonstration or video. Consideration should also be given to specifying in the requirements that this training should be relevant to the equipment and systems installed on the aircraft operated.

8.18.2 Scale of the Issue

General

The review of current cabin crew fire training programmes found that amongst some operators/training organisations, not all in-flight fire types relevant to the aeroplane operated were covered in theoretical training. It was found that some of the fire types were only addressed in the Operations Manual.

The review and comments from the online survey indicated that oven fire was one of the most practiced types of fires. Oven fire was identified as the most frequent fire type that had occurred on board UK registered aeroplanes in the period 2002-2006 (see Section 5.1), so it might be sensible to emphasise this type of fire in practical fire training scenario. However, this type of fire may not be the most severe in-flight fire threat, and other, more unlikely, fire situations may also need to be given attention in training proportional to their potentially higher severity. This is supported by the analysis of severity of fire/smoke events from the MOR data analysed (see Table 5.1-2 Proportion of Occurrences with a Severity Score of 11 and above in Each Location Category in Section 5.1), where it was found that the proportion of oven fire events having a severity score of 11 and above was found to be the lowest of the ten fire threats listed in the table.

Therefore, it is important that all relevant fire types be addressed in at least theoretical training. Ideally, such theoretical training should involve demonstration by video or by the instructor.

Electrical fires and In-flight Entertainment System fires

The study found that there were indications that training in dealing with fires and fire risks related to aircraft electrical systems was inadequate.

Many comments were received from the online survey indicating the need for more training on fires related to aircraft electrical systems (see Section 3.4.3):

"No mention in training about seat, in-seat IFE or battery fires from I-pods computers etc. This is however covered thankfully in our SEP manuals." (Cabin Crew)

"Fires inside the A/C do not just happen in toilets and galleys, with the introduction of IFE and the greater loading of the A/C systems, few crew understand the implications." (Instructor)

"... a lot of people don't seem to be familiar with power isolation, of IFE and also galley power." (Cabin Crew)

As a comparison, the US training organisation evaluated in this task provides four circuit breaker fire scenarios in the training simulator.

Of the 316 in-flight fire/smoke events reported in MORs, 288 of them involved electrical equipment/appliances, electrical components, and electrical wiring (see Section 5.1). Isolating power supply contributed to 13% of the problems cited in the MOR data analysed (see Section 5.3.7). The following is an extract from one of the reports:

"... The reporter expresses concern that although the cabin crew drill was actioned, power could not be isolated. After extensive investigation and following strip report and tests by the vendor, it was concluded that the system "disable" switch was switched off in error instead of the "cut off" switch which is the normal operation mode..."

The analysis of likely future threats found that the increasing length of flights would be combined with a direct increase in the installation of IFE and other systems such as in-seat power supply, with the potential to increase the frequency of in-flight smoke/fire occurrences attributable to these sources (see Section 5.5.3.1).

Additionally, the advances in electronics in recent years have resulted in a significant increase in the number and complexity of systems that are now installed on many aircraft. It is therefore essential that cabin crew are made aware of the restrictions on the resetting of circuit breakers and the consequences of not adhering to such restrictions. Consideration should be given to include the training of cabin crew on all electrical systems, including necessary precautions, the restrictions on the re-setting of circuit breakers related to in-flight fire situations and power isolation procedures.

PED and Lithium Battery Fires

The analysis of MOR data on in-flight fire incidents during 2002-2006 found two related to portable electronic devices:

"During the on board service, the sales computer indicated 'change battery' and failed to print. After the battery was changed the computer would still not print and the 'change battery' indication re-appeared. An electrical burning smell was then noticed coming from the printer area of the computer, so the battery and receipt roll were immediately removed. The receipt roll had a scorch mark on it and the computer was very warm to the touch. The reporter notes that the tech log carried four previous entries relating to sales computer faults. Engineering advised that contracted catering company supplies these units, and that no maintenance is carried out except replacement when defective. Contracted catering have advised that the units have been rectified following extensive testing and the fault will not recur."

"Sales computer overheated causing paper roll to catch fire and minor burn injury to cabin crew. Appropriate action/rectification of computers carried out by suppliers (contracted catering company)."

Even though the lithium battery fire occurrence rate appears to be low, it is paramount that cabin crew are aware of the specific procedures in dealing with PED fires. Work undertaken by the FAA has shown that dealing with PED fire requires methods that may appear in conflict with the general understanding of dealing with other types of electrical fire (i.e. cooling with water) and specific handling. Battery fires also have characteristics that may not present in any other fires (e.g. spontaneous jets of fire from the battery as the fire intensifies).

In addition, the analysis of likely future threats found that the increasing length of flights and/or the increasing numbers of long flights was likely to result in increases in the use of PED with the potential to increase the frequency of in-flight smoke/fire occurrences attributable to these sources. Therefore it was concluded that consideration might need to be given toward the need for specific crew training to combat fires associated with PED battery fires.

Multiple, simultaneous fires

Multiple, simultaneous fires are a serious fire threat that has not been considered in respect of cabin crew fire training. The review of current cabin crew fire training programmes found that no operator or training organisation included the issues of multiple internal fires and most operators had not given this any consideration. Most operators were of the opinion that this would be difficult to manage, especially with smaller aeroplanes with only a limited number of cabin crew (see Section 2.3).

The responses to the online survey for both in-flight fire experience groups show that the fire training was not considered adequate for preparing cabin crew to deal with multiple, simultaneous fires (see Section 3.4.2). Some of the comments highlighted the absence of procedures for this type of in-flight fire:

“Our fire drill involves 3 crew, so in the eventuality of a multiple fire situation, it is not laid out who should do what!” (Cabin Crew)

“No training for multiple fires at the same time onboard. This should also take into account the minimum crew on board the aircraft as this could be as little as four crew. Four crew with two fires no guidelines exist.” (Cabin Crew)

The review of in-flight fire accidents and incidents did not find any multiple, simultaneous fire events in the period analysed. Although the possibility of such an occurrence might be low, it has the potential to be of a very high severity with catastrophic consequences especially if there are no guidelines or recommended procedure on how to deal with it.

Flight Deck Fires

The MD11 flight deck fire in September 1998 clearly demonstrated just how quickly an in-flight fire situation could develop and rapidly become uncontrollable with catastrophic results. This is another area where there is no specific requirement in JAR-OPS 1 for a specific fire scenario to be included in the training of cabin crew.

In the event of a flight deck fire the cabin crew may need to intervene to provide firefighting support and back-up equipment since the flight crew workload is likely to be very high. The main consideration is that there should also be a procedure in place for cabin crew to access a ‘secured’ flight deck in order to provide firefighting assistance. Cabin crew will need to have specific procedures on how to deal with a flight deck fire, as well as knowledge of what actions the flight crew will be taking in respect of a diversion, emergency descent and/or landing, and the high level of workload that the flight crew will experience in such an event.

Requirements for practical fire scenarios to be relevant to the aircraft operated

The review of current cabin crew fire training programmes and comments from the online survey suggested that there were instances where cabin crew received practical training on fire scenarios that were not appropriate to the aircraft operated. In one case the fire scenario practiced (oven fire) was not relevant to their operations (no ovens installed on the aeroplane operated). This issue was also found with IFE fire, as reflected by a comment from the online survey (see Section 3.5.5):

"...I used to work for a low cost company and IFE fire was covered, low cost airlines do not have this." (Cabin Crew)

Therefore, it is considered important that the requirements specify that the fire scenarios covered in training should be relevant to the aircraft operated.

Optimising learning opportunities

Six of the practical training facilities visited in this study provided one or two fire scenarios (typically oven/galley fire or lavatory fire), and four facilities provided three to five fire scenarios. In most cases, each trainee only dealt with one fire scenario (see Section 2.2.2). It is quite likely that the majority of cabin crew would only have practical training in dealing with one fire scenario of fire during their service.

The responses to the online survey indicated that some cabin crew would like to have more training, preferably practical, on varied fire types/fire scenarios (see Section 3.4.3):

" Concentration is mainly on the distinguishing of toilet and oven fires. Aircraft panels and electrical fires are only discussed in the theoretical side of fire training, yet we as cabin crew are taught that a fire on board an aircraft could result in a catastrophic situation. All fires need to be fully covered – not simply showing cabin crew how to open a toilet door if a suspected fire is behind it!!" (Cabin Crew)

" There isn't much time to go through all fire scenarios so only one-two are chosen and specialised in. The more unlikely fire situations are always an eye opener and I always learn a lot from. Would be more useful for a lot more scenarios/situations." (Cabin Crew)

Considering the limited amount of time allocated to practical fire training, the observation of other trainees' performances is a very useful learning tool. However, as observed during the visits, this was not always carried out. Consideration should also be given to alternating different fire scenarios in Recurrent Training to broaden cabin crew firefighting skills, as suggested by a respondent to the online survey:

" We look at dealing with fires in ovens, toilets (waste bin at present) & overhead lockers. It may also be useful to look at situations such as waste bins/waste bags, baggage in cabin, IFE systems, Flight Deck and seat cushions. Perhaps alternate each year with different scenarios..." (Instructor)

8.18.3 Associated Current Regulatory Material

General

JAR-OPS 1 requirements do not specify the types of in-flight fires that should be dealt with in cabin crew fire training. It is not specified in the requirements that the fire types/scenarios covered in theoretical and practical fire training should be relevant to the type of aircraft and type of operations of the operator.

It is understood that procedures for dealing with various fire types/fire scenarios would be included in the Operator's Standard Operations Manual, as suggested by UK CAA CAP 648 (Specimen A to B Standard Operations Manual (Aeroplanes)) Addendum 1 Chapter 4 (Emergency Procedures), Paragraph 4.19.1 (e):

4.19.1 Procedures and equipment required to enable cabin crew to deal successfully with any type of in-flight fire.

- (e) Specific Fire Scenarios – Procedures for dealing with specific in-flight fire characteristics of the aeroplane interior. This may include:
- (i) Galley;
 - (ii) Underfloor;
 - (iii) Toilet;
 - (iv) Oven;
 - (v) Waste containers;
 - (vi) Overhead bins;
 - (vii) Freight;
 - (viii) Baggage;
 - (ix) Seat;
 - (x) Electrical;
 - (xi) Flight deck;
 - (xii) Lift;
 - (xiii) In-flight Entertainment System;
 - (xiv) Closet; and
 - (xv) Catering equipment/supplies.

There is no specific training requirement that addresses the restrictions on the resetting of circuit breakers. However, UK CAA CAP 768, Chapter 33, Paragraph 17.1 addresses this subject:

17.1 In-flight use of circuit breakers will usually involve the action of resetting a circuit breaker which has tripped because of an electrical overload or fault. The reestablishment of electrical power to a circuit which is at fault involves an element of risk. In flight, cabin crews should not reset CBs associated with domestic services/equipment such as ovens, water boilers etc. because, by definition, the circuits involved are mostly within passenger areas and the inconvenience caused by the loss of service would not justify any possible distress occasioned by 'electrical smells'. Resetting of circuit breakers is only allowed in accordance with the flight manual procedures and when there is no associated condition of smoke or fumes. A second reset should not be attempted.

Lithium battery fire is addressed in CAP 768 Chapter 33 Paragraph 8.1. FODCOM 12/2008 provides guidance and a checklist on dealing with cabin fires caused by lithium batteries in portable electronic devices.

8.18.4 **Foreign Comparable Regulatory Material**

TCCA Flight Attendant Training Standard (Reference 10) for Initial and Annual Fire Fighting Training requires cabin crew members to:

4.1C.1 Describe the fire fighting procedures for specific types of fires (e.g. galley, oven, lavatory, electrical, upholstery, etc.).

4.1C.2 Describe the techniques and procedures for fighting these fires including finding the source of the fire, type of extinguisher to use, additional fire fighting equipment needed, complications to fighting these types of fires, limitations to fighting this type of fire, post-fire procedures, crew communication and coordination procedures, and passenger-handling.

TCCA Flight Attendant Training Standard (Reference 10) for Simulation Scenarios in Initial (7.8.2) and Annual (7.6.2) Fire Fighting Drill state:

- a. Cabin fire fighting drills may include class A, B, C fires in the following locations:
 - (i) Cabin area (e.g. under seat, overhead bin, closet);
 - (ii) Galley area (e.g. garbage bin, upper electrical panel, oven);
 - (iii) Confined area (e.g. waste bin, lavatory); and
 - (iv) Hidden (e.g. behind panels).

The Federal Aviation Regulation for Part 121 Subpart N Section 121.417 (Reference 11) requires:

- (b) Emergency training must provide the following:
 - (3) Instruction in the handling of emergency situations including—
 - (ii) Fire in flight or on the surface, and smoke control procedures **with emphasis on electrical equipment and related circuit breakers found in cabin areas including all galleys, service centers, lifts, lavatories and movie screens**

FAA Advisory Circular No. 120-80 addresses the potential hazards associated with tripped circuit breakers and restrictions in resetting them.

The US FAA General Technical Administration Volume 3 Chapter 23 Section 6 (Reference 13) Paragraph 3-1851 states:

FIRE PREVENTION. This section addresses the need for certificate holders to review their approved training programs and flight attendant manuals to ensure that the procedures used by air carriers properly address the concerns expressed in this section.

- A. Crewmember emergency training requires certificate holders to give instruction in the handling of emergency situations, which include potential fire problems related to electrical equipment and circuit breakers.
 - 1) On some aircraft, electrical equipment and related circuit breakers are located in cabin areas including all galleys, service centers, lifts, lavatories, and movie/video centers.
 - 2) Training on the location, function, and related safety procedures for electrical equipment and circuit breakers should focus on eliminating a problem before it becomes a safety hazard

8.18.5 Possible Change to Current Regulatory Material

Training Affected

Conversion and Differences Training

Recurrent Training (3-yearly)

Proposed Change to Future European Aviation Requirements

It is proposed that consideration be given by EASA to amending Conversion and Differences Training and Recurrent Training to add the following:

- (1) Each cabin crew member is given theoretical training on all of the fire scenarios and the associated fire-fighting procedures relevant to the aeroplane operated. The fire scenarios may include (as applicable):
 - i. Seat fire;
 - ii. Overhead bin fire;
 - iii. Toilet fire;
 - iv. Galley fire, including oven fire, coffee makers and other galley appliances/ catering equipment and supplies;
 - v. Waste containers fire;
 - vi. In-flight Entertainment System fire;
 - vii. Portable Electronic Devices/lithium battery fire
 - viii. Flight deck fire;
 - ix. Electronic and Equipment bay fire;
 - x. Crew rest area fire;
 - xi. Cargo fire (if accessible from the cabin);
 - xii. Underfloor fire;
 - xiii. Electrical fires and the necessary power isolation procedures;
 - xiv. Lift;
 - xv. Closet; and
 - xvi. Multiple fires and associated security aspects.
- (2) Each cabin crew member is given realistic and practical training on fire fighting procedures which may involve class A, B, C fires in various locations relevant to the aeroplane operated, which may include:
 - (i) Cabin area (e.g. seat, overhead bin, closet);
 - (ii) Galley area (e.g. waste container, oven, upper electrical panel);
 - (iii) Confined area (e.g. crew rest compartment, lavatory); and
 - (iv) Hidden (e.g. behind panels).

Proposed Guidance Material

It is proposed that consideration be given by UK CAA (and/or EASA) to providing guidance material containing:

- The techniques and procedures for dealing with each fire threat listed in the proposed change to future European aviation requirements above.
- Required knowledge of all electrical systems and equipment installed in the cabin and any areas accessible to cabin crew, as well as the location of associated circuit breakers, power isolation procedures and the restrictions on the resetting of circuit breakers.
- Required demonstration (or video) of dealing with Lithium Battery fires.

- Recommended procedures for dealing with multiple, simultaneous fires and the associated security issues.
- The specific cabin crew procedures to deal with flight deck fires which are consistent with flight crew procedures.
- Recommendation for conducting theoretical training by demonstration (by video or by instructors) instead of training by instruction only.
- The advantages and methods of exposing cabin crew to as many fire scenarios as possible. The methods listed can be, for example:
 - Observation of other trainees' performance during practical training, ideally on different fire scenarios; or
 - Alternating fire scenarios every practical training session undertaken by a cabin crew member.

8.18.6 **Safety, economic and Environmental Impacts**

Safety Impact

The proposed change is intended to ensure that cabin crew fire training provides the necessary knowledge and skill in dealing with all potential in-flight fire threats. The proposed change would affect the majority of operators and is likely to have a substantial effect in improving cabin crew's knowledge, and to some extent, cabin crew's firefighting skills. The proposed amendment to future European aviation requirements would ensure that the resulting increased safety level is attained throughout the industry.

Economic Impact

The implementation of the proposed change is likely to incur some additional costs to the operators due to:

- Incremental costs related to the modification to fire training facilities to add more fire scenarios.
- Incremental costs related to the development and production of training video.
- Incremental costs related to the increased instructor man hours.
- Incremental costs related to the increased cabin crew non-revenue time.
- Amendment and change to Training Manuals and Operations Manuals.

There would be costs incurred to the authorities in developing the guidance material and costs related to the regulatory process in amending future European aviation requirements.

Environmental Impact

None identified.

8.18.7 **Summary**

Based on the findings from the review of current cabin crew fire training programmes, the online survey, and the accident/incident data analysis, it is evident that training requirements for various fire scenarios need to be addressed. It was also found that this subject is addressed in US FAA and Transport Canada Civil Aviation regulatory material. Whilst the economic impacts need to be taken into consideration, addressing this subject in future European aviation requirements will ensure that an improved safety level can be achieved throughout the industry. Detailed guidance material will support the proposed requirements and ensure that operators adopt the best practice in carrying out theoretical and practical training in dealing with various types of in-flight fires.

8.19 **Requirement for the use of Protective Equipment during Firefighting Training**

8.19.1 **Description of Issue**

The study found that the use of protective equipment such as PBE and fire gloves when fighting a fire could present difficulties to cabin crew. Therefore, consideration should be given to reflect this in practical training.

8.19.2 **Scale of the Issue**

The review of current cabin crew fire training programmes found that only two of the ten operators/'third party' training organisations visited required cabin crew to fight a fire whilst wearing PBE during practical training in extinguishing (see Section 2.2.2). As a comparison, at the US training organisation evaluated in this task, each trainee enters the "fire trainer" and extinguishes a live fire whilst wearing PBE, as required by FAR 121.417 (c)(1)(i) (see Section 8.19.4 below). Wearing fire gloves and breathing equipment during practical fire training was also observed in the Royal Navy and the Royal Air Force crew fire training (see Section 4.1 and 4.2).

Approximately 44% of the problems in operating fire extinguishers when dealing with an in-flight fire reported by UK respondents to the online survey were related to discharging the fire extinguisher. Some of these were due to the difficulty in discharging the fire extinguisher while wearing fire gloves (see comments in Section 3.7).

"When you have the fire gloves on it is difficult to operate the extinguisher..."
(Cabin Crew)

"The Green BCF was used in conjunction with the fire gloves. It was made difficult to place fingers in to the wells provided as this is not the biggest area when wearing the fire gloves." (Cabin Crew)

Currently, there is no requirement for cabin crew to conduct practical fire training whilst wearing the appropriate protective equipment available on board. Some respondents to the online survey suggested firefighting training should be carried out while using the appropriate protective equipment such as fire gloves and PBE (see Section 3.5.5):

"We do not practice fighting (simulated) fires while wearing the appropriate safety equipment - smoke hood & gloves - so the first time these are worn while trying to let off an extinguisher is the day it happens for real." (Flight Crew)

"Smokehoods should be worn while discharging an extinguisher with BCF characteristics into spaces that represent panels and toilet bins, allowing crew to familiarise themselves with the limitations to vision and communication that such a scenario entails. Merely squirting water into an oven-shaped box without any protective equipment on is not adequate training." (Flight Crew)

8.19.3 **Associated Current Regulatory Material**

JAR-OPS 1 requirements do not require cabin crew to conduct practical fire training whilst wearing Protective Breathing Equipment and/or fire gloves.

8.19.4 **Foreign Comparable Regulatory Material**

The requirement for wearing PBE during fire extinguisher training is found in TCCA Flight Attendant Training Standard (Reference 10) for Initial Fire Fighting Drill:

7.8.5 Live Fire Fighting Drill

- a. Each trainee shall demonstrate the effectiveness of a fire extinguisher correctly applied to an actual fire **while wearing a P.B.E.**

A similar requirement is also applicable for the Annual Fire Fighting Drill:

7.6.8 Live Fire Fighting

Once every third annual training year, each crew member shall demonstrate the effectiveness of a fire extinguisher correctly applied to extinguish an actual fire **while wearing P.B.E.**

The requirement for crew member emergency training in US Federal Aviation Regulation Section 121.417 (Reference 11) requires firefighting training while wearing PBE:

- (c) Each crewmember must accomplish the following emergency training during the specified training periods, using those items of installed emergency equipment for each type of airplane in which he or she is to serve (Alternate Recurrent Training required by Sec. 121.433(c) of this part may be accomplished by approved pictorial presentation or demonstration):

- (1) One-time emergency drill requirements to be accomplished during Initial Training. Each crewmember must perform—
 - (i) At least one approved protective breathing equipment (PBE) drill in which the crewmember combats an actual or simulated fire using at least one type of installed hand fire extinguisher or approved fire extinguisher that is appropriate for the type of actual fire or simulated fire to be fought **while using the type of installed PBE required by Sec. 121.337 or approved PBE simulation device as defined by paragraph (d) of this section** for combating fires aboard airplanes;

The US FAA General Technical Administration Volume 3 Chapter 23 Section 6 (Reference 13) Paragraph 3-1858 B 2) supports this requirement.

- B. The following two drills are associated with fire control.

- 2) PBE/Firefighting Drill. A PBE/firefighting drill is a one-time requirement consisting of two exercises. Exercise one requires crewmembers **to operate the PBE while fighting an actual or simulated fire**. Exercise two requires crewmembers to discharge a fire extinguisher and fight an actual fire. The exercises of this PBE/firefighting drill may be combined. When the air carrier combines the exercises of the PBE/firefighting drill, the crewmember discharges a fire extinguisher while fighting an actual fire and while wearing PBE.

8.19.5 **Possible Change to Current Regulatory Material**

Training Affected

Conversion and Differences Training

Recurrent Training (3-yearly)

Proposed Change to Future European Aviation Requirements

It is proposed that consideration be given by EASA to amending Conversion and Differences Training and Recurrent Training to add the following:

An operator shall ensure that each cabin crew member is given realistic and practical training in the use of all fire fighting equipment including protective clothing representative of that carried in the aeroplane. This training must include:

Each cabin crew member extinguishing a fire characteristic of an aeroplane interior fire whilst wearing PBE and fire gloves and other protective clothing (if applicable), except that, in the case of Halon extinguishers, an alternative extinguishing agent may be used.

Proposed Guidance Material

It is proposed that consideration be given by UK CAA (and/or EASA) to providing guidance material to address the use of PBE, fire gloves and protective clothing based on the proposed change to future European aviation requirements above.

8.19.6 **Safety, economic and Environmental Impacts**

Safety Impact

It is likely that practical experience for cabin crew in firefighting whilst wearing the protective equipment to be worn in an actual in-flight fire/smoke event would have a substantial effect in mitigating the difficulties associated with this issue. It was assessed that this improvement will benefit the majority of operators.

Economic Impact

The use of PBE will not incur any additional cost (since it is already required for smoke training). The use of fire gloves is only as applicable (i.e. when available on board, since such equipment is not a required item of safety equipment) and this will incur some costs. Protective clothing is normally only provided for cabin crew involved in 'combi' operations, i.e. the carriage of cargo on the main deck of an aeroplane, and this too will incur some costs. Other cost to the operators associated with the proposed change is related to the amendment and change to Training Manuals and Operations Manuals.

There would be costs incurred to the authorities in developing the guidance material and costs related to the regulatory process in amending future European aviation requirements.

Environmental Impact

None identified.

8.19.7 **Summary**

Findings from the review of current cabin crew fire training programmes, the online survey, and the review of non-civil aviation training programmes indicated that the use of protective equipment needs to be incorporated in firefighting training. It was also found that this subject is addressed in US FAA and Transport Canada Civil Aviation regulatory material. Whilst the economic impacts need to be taken into consideration, addressing this subject in future European aviation requirements will ensure that an improved safety level can be achieved throughout the industry. Detailed guidance material will support the proposed requirements and ensure that operators adopt the best practice in carrying out practical training in operating fire extinguishers.

8.20 **Requirement for Theoretical Training in Conversion and Differences Training and Recurrent Training**

8.20.1 **Description of Issue**

The study found that theoretical fire training is only specified in Initial Training (Appendix 1 to JAR-OPS 1.1005 (b)). Considering the importance of the subjects addressed during theoretical training and to ensure knowledge retention, consideration should be given to amending future European aviation requirements to include theoretical training requirements in Recurrent Training. Due to the aircraft type-specific nature of some of the subjects, it is also considered logical to incorporate theoretical training in Conversion and Differences Training. Additionally, the potential impact under EU-OPS for cabin crew 'attestation' may result in some or all of Initial Training being transferred between operators, even though some of the Initial Training issues relevant to cabin crew fire training may not be generic.

8.20.2 **Scale of the Issue**

Review of cabin crew fire training programmes found that incorporating theoretical fire training into Conversion and Differences Training and Recurrent Training would encourage operators to have more meaningful firefighting training by combining both the theoretical and practical training elements into one session.

At the time of the review, the important issues covered during theoretical fire training were only required to be trained on a 'once only' basis during Initial Training although many operators did provide such training on a recurrent basis.

The online survey found that some respondents expressed their concern on the lack (or absence) of theoretical training in Recurrent Training (see Section 3.3.1):

"I believe that the [theoretical] training, when given, is sufficient, but is forgotten quickly so there should be more refreshers." (Flight Crew)

"Initial Training – sufficient. Recurrent Training - not enough time spent on theory." (Instructor)

Recurrent Training should either include or repeat the requirements of Initial Training, since the important issues covered in theoretical training need to be dealt with on a recurrent basis rather than a once only basis. Since much of the theoretical cabin crew firefighting training is actually aircraft-type related, transferring some of these items to Conversion and Differences Training in addition to repeating them in Recurrent Training would be a logical step.

As observed in the RAF air crew training, the same theoretical training was carried out during both Initial Training and Recurrent Training (see Section 4.2.4).

8.20.3 **Associated Current Regulatory Material**

INITIAL TRAINING – Appendix 1 to JAR-OPS 1.1005 (b)

- (b) Fire and smoke training. An operator shall ensure that fire and smoke training includes:
- (1) Emphasis on the responsibility of cabin crew to deal promptly with emergencies involving fire and smoke and, in particular, emphasis on the importance of identifying the actual source of the fire;
 - (2) The importance of informing the flight crew immediately, as well as the specific actions necessary for coordination and assistance, when fire or smoke is discovered;
 - (3) The necessity for frequent checking of potential fire-risk areas including toilets, and the associated smoke detectors;
 - (4) The classification of fires and the appropriate type of extinguishing agents and procedures for particular fire situations, the techniques of application of extinguishing agents, the consequences of misapplication, and of use in a confined space; and
 - (5) The general procedures of ground-based emergency services at aerodromes.

8.20.4 **Foreign Comparable Regulatory Material**

Transport Canada Civil Aviation requires theoretical training to be carried out during Initial and Annual Fire Fighting Training, as set out in the Flight Attendant Training Standard (Reference 10) Initial Part Four and Annual Part Four. The theoretical training covers General, Crew Responsibilities, Procedures – Cabin, and Procedures External. The subjects required for both Initial and Annual Training are identical although Initial Training includes a few more subjects in General and Crew Responsibilities.

8.20.5 **Possible Change to Current Regulatory Material**

Training Affected

Conversion and Differences Training

Recurrent Training (3-yearly)

Proposed Change to Future European Aviation Requirements

It is proposed that consideration be given by EASA to amending Conversion and Differences Training and Recurrent Training to add the requirements of theoretical fire training in the following subjects:

- 1 Emphasis on the responsibility of cabin crew to deal promptly with emergencies involving fire and smoke and, in particular, emphasis on the importance of identifying the actual source of the fire;
- 2 The importance of informing the flight crew immediately, as well as the specific actions necessary for coordination and assistance, when fire or smoke is discovered;
- 3 The necessity for frequent checking of potential fire-risk areas including toilets, and the associated smoke detectors;

- 4 The classification of fires and the appropriate type of extinguishing agents and procedures for particular fire situations, the techniques of application of extinguishing agents, the consequences of misapplication, and of use in a confined space; and
- 5 The general procedures of ground-based emergency services at aerodromes.
- 6 Communication/coordination with flight crew during an in-flight fire/smoke event;
- 7 Assessing and locating fire;
- 8 Procedures and techniques for dealing with various fire scenarios;
- 9 Management of passengers during an in-flight fire event; and
- 10 Prevention measures and safe work habits.

Note that subjects (6) to (10) are already proposed separately in other parts of Section 8.)

Proposed Guidance Material

It is proposed that consideration be given by UK CAA (and/or EASA) to providing guidance material to address the inclusion of theoretical training in Conversion and Differences Training and Recurrent Training based on the proposed change to future European aviation requirements above.

8.20.6 Safety, economic and Environmental Impacts

Safety Impact

Carrying out theoretical training during Conversion and Differences Training will be appropriate especially for subjects that are aircraft type-specific, whilst theoretical training as part of Recurrent Training will ensure knowledge retention. Combining theoretical and practical training will also ensure that the theoretical knowledge acquired by cabin crew can be applied during practical training as appropriate. Overall, it is likely that the proposed change would have a significant beneficial effect in improving cabin crew's skill and knowledge in dealing with an in-flight fire/smoke event.

Economic Impact

The implementation of the proposed change is likely to incur some additional costs to the operator due to:

- Incremental costs related to the increased instructor man hours.
- Incremental costs related to the increased cabin crew non-revenue time.
- Amendment and change to Training Manuals and Operations Manuals.

Environmental Impact

None identified.

8.20.7 **Summary**

As suggested by findings from the review of current cabin crew fire training programmes, the online survey, and the review of non-civil aviation training programmes, consideration needs to be given to include theoretical training in Conversion and Differences Training and Recurrent Training. It was also found that Transport Canada Civil Aviation minimum training requirements specify theoretical training during Initial and Annual Training. Whilst the economic impacts need to be taken into consideration, addressing this subject in future European aviation requirements will ensure that an improved safety level can be achieved throughout the industry. Detailed guidance material will support the proposed requirements and ensure that operators and training organisations adopt the best practice in carrying out fire training.

8.21 **Requirement for the Regulation of Training Provided by 'Third-Party' Training Organisations**

8.21.1 **Description of Issue**

The study identified problems in terms of the conformity of the training provided by third-party organisations with the operators' training requirements and operating procedures. Consideration should be given to developing guidelines for operators and 'third-party' training organisations so as to ensure that there is an effective level of liaison between operators and training organisations and oversight by both parties. Such guidelines should ensure that there is an acceptable level of consistency between the training that is delivered by the 'third-party', and the operator's aeroplanes, firefighting equipment and operating procedures as specified in the individual Operations Manuals and Training Manuals.

8.21.2 **Scale of the Issue**

The visits to 'third-party' training organisations raised significant concerns regarding consistency between operators' procedures (i.e. as contained in their Operations and Training Manuals) and the training delivered by some 'third-party' training organisations (see Section 2.9). The problems were mostly due to the lack of liaison between the operator and the training organisation and vice versa.

In some cases, the 'third-party' training organisation lacked the specifics related to operator's procedures, equipment, and relevant aircraft information. In most cases the 'third-party' training organisation had never attended the relevant theoretical parts of cabin crew training provided by the operator.

In some cases the 'third-party' training organisation had no access to the operator's Training Manual and Operations Manual, and as a result had little or no idea of what they were certificating in respect of cabin crew fire training. In some cases there was a lack of oversight by the operator as to what was being provided by the 'third-party' training organisation.

The comments received by respondents of the online survey who receive/provide training from a 'third-party' training organisation also supported this (see Section 3.6.1):

"At times using a 'third-party' training provider fire fighting procedures can sometimes inadvertently contradict what the company procedures state. This being because fire officers are enlisted to train our practicals and we do not have one of our instructors present. Therefore, you can get the fire officers view point, which at times can be useful, but it should be consistent with the company procedure so as not to cause any confusion." (Cabin Crew)

The visit to the Royal Navy revealed a training arrangement between the Royal Navy and their 'third-party' training organisation that seemed to address this problem, whereby the involvement of Royal Navy instructors ensured that the delivery of training always conformed to Royal Navy training requirements (see Section 4.1).

As found in the review of current cabin crew fire training programmes, it appeared that if both the operator and the 'third-party' training organisation worked closely together, the potential problems in respect of compatibility and consistency between the procedures in the operators' Operations/Training Manuals and the actual training provided, could be overcome. The operator has to ensure this consistency (and compliance with relevant requirements). In addition, instructors from 'third-party' training organisations' need to be knowledgeable of the operator's equipment and any other relevant aeroplane information and operating procedures applicable to the training being provided. Instructors from 'third-party' training organisations would also need a greater understanding of relevant requirements and associated guidance material.

8.21.3 **Associated Current Regulatory Material**

There is no requirement or guidance material addressing the need for ensuring that the procedures and training content of fire training provided by 'third-party' training organisations conforms to Operators' Training Manuals and Operations Manuals.

However, CAP 768 Chapter 29 Paragraph 21.1 states:

Consideration should be given to reviewing the credentials of training personnel (third party or otherwise), ensuring that all fire fighting equipment, protective breathing equipment and fire extinguishers used during the training are fully representative of the equipment carried on board. Additionally, all fire fighting techniques, procedures and terminology incorporated into practical training should represent those of the operator.

This is supported by CAP 768, Chapter 29, Paragraphs 5.1:

Operators may use third party training organisations, which might include other AOC holders, to carry out mandatory training on their behalf. Under the terms of their AOC, operators are wholly responsible for the course content and this should be detailed in the Operations Manual Part D - Training. It is important for operators to monitor third party training to ensure full compliance with the current requirements, the procedures laid down in their Operations Manual Part D - Training and the applicability to their specific operation.

8.21.4 **Foreign Comparable Regulatory Material**

There are no requirements that specifically address this subject in Transport Canada Civil Aviation or US FAA regulatory material.

8.21.5 **Possible Change to Current Regulatory Material**

Training Affected

Initial Training

Conversion and Differences Training

Recurrent Training

Proposed Change to Future European Aviation Requirements

It is proposed that consideration be given by EASA to amending Initial Training, Conversion and Differences Training and Recurrent Training to add the following:

When fire training is provided by a 'third-party' training organisation, operators shall monitor such training on a regular basis so as to ensure that such training is fully compliant with the requirements of this Subpart, and that it is consistent with the procedures in their Operations Manual Part D and with the applicability to the specific operation.

Proposed Guidance Material

It is proposed that consideration be given by UK CAA (and/or EASA) to address this subject based on the proposed change to the future European aviation requirements above and CAP 768. Consideration should also be given to establishing guidelines for 'third-party' training organisations in providing fire training for cabin crew and flight crew.

8.21.6 Safety, economic and Environmental Impacts

Safety Impact

Training that does not conform to the operator's procedures and training requirements may potentially result in cabin crew applying incorrect procedures during an actual in-flight fire event, possibly exacerbating the situation. It is likely that the proposed change would have a substantial effect in improving the quality of fire training delivered by 'third party' training organisations and thus the skills of cabin crew in dealing with in-flight fire events.

It was assessed that the safety benefits that may be accrued by providing guidance material to address this subject would apply to a reasonable number of operators using 'third-party' training organisations.

Economic Impact

The proposed change will not affect operators carrying out in-house fire training. Operators using 'third-party' training organisations are likely to need resources to supervise and/or oversee the training provided.

There would be costs incurred to the authorities in developing the guidance material and costs related to the regulatory process in amending future European aviation requirements.

Environmental Impact

None identified.

8.21.7 Summary

Findings from the review of current cabin crew fire training programmes, the online survey, and the review of non-civil aviation training programmes indicated that there needs to be a means to ensure that the training provided by 'third-party' training organisations is consistent with the operator's Operating Manuals and Training Manuals. Whilst the economic impacts need to be taken into consideration, addressing this subject in future European aviation requirements will ensure that an improved safety level can be achieved throughout the industry. Guidance material will support the proposed requirements and provide the information required by operators as well as 'third-party' training organisations.

8.22 Guidelines for Training Methods in Performing Firefighting Procedures

8.22.1 Description of Issue

The study found that fire training scenarios during practical training should be conducted such that cabin crew follow the specific operator's procedures for dealing with an in-flight fire as well as using judgment and common sense with regard to implementing the in-flight firefighting procedure that incorporates the three roles of the cabin crew (i.e. Firefighter, Assistant Firefighter/Coordinator, and Communicator, also known as 'ABC' procedure). Additionally, there is no recommended in-flight fire procedure for single cabin crew operations.

8.22.2 Scale of the Issue

The need for guidelines on training in firefighting procedures

The comments received from the online survey indicated the concerns with the prescriptive nature of the firefighting procedure and its training (see Section 3.6.1):

"I am concerned that the training is too prescribed and procedural, making crew feel scared to act unless they are in the correct role. 'No I can't help you fight the fire because I'm the communicator'!!!" (Cabin Crew)

"The cabin crew procedures are very prescriptive and rely on defined roles in the event of a fire. Cabin crew are never encouraged in training to use their own judgement or indeed common sense. In simulation scenarios they are so wrapped up in following the 'rules' that it takes a long time to actually tackle any fire..." (Flight Crew)

Some comments also drew attention to the potential difficulty of applying the ABC procedure with minimum crew complement, even if that still consisted of at least three crew members (see Section 3.11):

"Make airlines insist that crewing levels in all galleys are sufficient that at least 3 crew are in every galley, not the usual airline operators excuse that there is 1 crew member in one galley and there are 2 in the next galley and that's sufficient. Question is what if those 2 are out in the cabin dealing with another issue, medical emergency perhaps. Cutbacks are the airlines way but one fatal fire and they will only have themselves to blame!" (Cabin Crew)

"The procedures may be right but the actual situation it may not happen like that. Also with less crew now on board the ability to have 3 crew in the fire fighting scenario is not going to happen in the quickest response time. Have spent many times flying when I have been the only crew member around for great lengths of time and had there been a fire, particularly late night flying, there is no way that crew could extinguish and communicate and co-ordinate a fire procedure. Crewing levels are too low for this to happen effectively!" (Cabin Crew)

This indicates that some cabin crew perceived the ABC procedure as the only course of action to follow even if the particular circumstances of an in-flight fire event might make it impractical to do so. It appeared that the way that the firefighting procedure had been indoctrinated and trained might dissuade cabin crew from using their common sense and judgment, which could be detrimental considering the unpredictable nature of in-flight fire events.

Firefighting procedure for single cabin crew operations

It was concluded from the review of current cabin crew fire training programmes that in respect of single cabin crew operations, it was doubtful if one crew member could act as firefighter/co-coordinator/communicator as well as dealing with the issues of

passenger management (see Section 2.10). One single cabin crew operator placed significant reliance on an Able Bodied Person (ABP), and this was also applied by the US training organisation evaluated in this study, whilst another single cabin crew operator used the accepted industry-wide 'ABC' firefighting procedure in their Operations Manual. In the case of one operator with both one and two cabin crew operations, there were no significant differences detailed in their firefighting procedures.

Responses to the online survey from crew of smaller aircraft types highlighted the need to have in-flight firefighting procedures that specifically cater for operations with less than three cabin crew, especially single cabin crew operation (see Section 3.11), as reflected in the following comment:

"Perhaps stronger regulatory guidance or a standard for single (or no) cabin crew operations." (Instructor)

"Specific to a/c with one cabin crew. Management of pax whilst fighting the fire in a situation where crew are obliged to don breathing apparatus (no communication with pax) I feel would be un-manageable." (Flight crew)

8.22.3 **Associated Current Regulatory Material**

There is no requirement or guidance material regarding how in-flight firefighting procedures are developed and trained.

There is no requirement or guidance material for dealing with an in-flight fire for those operations that only have one required cabin crew member on board the aircraft.

8.22.4 **Foreign Comparable Regulatory Material**

In AC 120-80 (Reference 12), it was stated that:

Crewmembers should consider deadheading crewmembers and able-bodied passengers (ABP) as additional resources when combating a fire. The ability to enlist the help of qualified individuals, **especially on a single flight attendant operation**, might be very valuable in combating a fire and communicating with the flight deck crewmembers. Regardless of the type of operation, crewmembers should consider and use all available resources when faced with an in-flight fire.

8.22.5 **Possible Change to Current Regulatory Material**

Training Affected

Initial Training

Conversion and Differences Training

Recurrent Training

Proposed Guidance Material

It is proposed that consideration be given by UK CAA (and/or EASA) to providing guidance material regarding how in-flight firefighting procedures are developed and trained. The guidance material may include examples on methods of training in in-flight firefighting procedures, where cabin crew would follow the specific operator's procedures as well as using judgment and common sense. An example of this could be implementing "surprise" scenarios during fire training where less than the normal crew complement is available, or more than one fire has to be dealt with. This could be performed once every training session as an example, or at least discussed during training.

It is also proposed that consideration be given by UK CAA (and/or EASA) to providing guidance material for an in-flight firefighting procedure for operations that only have one required cabin crew member on board the aircraft.

8.22.6 **Safety, economic and Environmental Impacts**

Safety Impact

Considering the unpredictable nature of in-flight fire events, the ability of cabin crew to follow procedure without disregarding common sense in an in-flight fire event is likely to improve the overall safety level.

For operators with single cabin crew, guidance with regard to an in-flight firefighting procedure is greatly needed considering the absence of a prescribed procedure specifically for single cabin crew operation.

Economic Impact

Operators may incur costs in establishing, developing and/or changing procedures as well as amendment of Training Manuals and Operations Manuals.

There would be costs incurred to the authorities in developing the guidance material.

Environmental Impact

None identified.

8.22.7 **Summary**

Based on the findings from the review of current cabin crew fire training programmes and the online survey, consideration should be given to providing guidelines on the training of in-flight firefighting procedures and development of procedures for single cabin crew operations. Detailed guidance material addressing these subjects is likely to improve the quality of training and ensure that cabin crew are prepared for the unpredictable nature of in-flight fire events.

8.23 **Guidelines for Implementing Integrated Fire Training Scenarios in a Cabin Environment**

8.23.1 **Description of Issue**

As currently written, the requirements of JAR-OPS 1 allow aspects of practical fire and smoke training to be conducted separately and do not require any related fire scenarios to be incorporated into an integrated practical exercise. This means that the current fire training for cabin crew can be conducted in isolated sessions and thus proficiency in a combined and integrated practical exercise cannot be demonstrated.

8.23.2 **Scale of the Issue**

The review of current cabin crew fire training programmes found that only one operator (out of the ten operators/'third party' training organisations visited) employed an integrated fire scenario during practical training, where the exercise encompassed all aspects of the operator's smoke and fire drills. In this case, the cabin crew had to first contact the flight crew and then commence the full fire drill, including donning PBE, locating and obtaining the fire extinguisher, fighting the fire and subsequent dampening down by using non-flammable liquid and representative galley equipment. Management of passengers and communication with the flight crew was continuous throughout this exercise (see Section 2.2.2).

As discussed in Section 3.5.5, an integrated fire-training scenario, where all aspects of an in-flight fire are realistically present and cabin crew are required to carry out the entire elements of fire training, appears to be the ideal scenario. By implementing an integrated scenario, the training would not only include the firefighting technique and procedures, but also include locating and accessing the fire, locating and removing firefighting equipment, and wearing protective equipment during the entire process.

The visit to the Royal Navy revealed that practical training carried out integrated the use of breathing equipment in a smoke-filled environment, the removal and use of an extinguisher on a fire, and the execution of procedures in various scenarios in the mock-up, which also included communication (see Section 4.1.5). The practical training observed for the Royal Air Force crew also practiced integrated fire training scenarios (see Section 4.2.5).

It is questionable whether the cabin crew are adequately prepared by completing lots of separate parts of training in different training facilities and never experience performing the entire procedures and techniques in a scenario in a cabin environment.

8.23.3 **Associated Current Regulatory Material**

There is no current regulatory material relevant to this subject.

8.23.4 **Foreign Comparable Regulatory Material**

TCCA Flight Attendant Training Standard (Reference 10) Performance Criteria in Fire Fighting Drill in Initial (7.8.6) and Annual training (7.6.4) incorporates all elements of the firefighting drill:

7.8.6 Fire Fighting - Cabin - Performance Criteria

- a. Each trainee shall demonstrate the ability to carry out fire fighting procedures in a cabin environment as a primary fire fighter and perform the following:
 - i. Recognize that there is a potential fire situation (e.g. smoke detector signal or unusual fumes, odours);
 - ii. Locate the source of fire;
 - iii. Apply communication/co-ordination procedures;
 - iv. Select and remove the nearest appropriate fire extinguisher and (if applicable) other fire fighting equipment;
 - v. Inform, assist and control passengers;
 - vi. Operate the extinguisher; and
 - vii. Monitor for re-ignition, and apply post-fire follow-up procedures.

7.6.4 Cabin Fire Fighting Drill Performance Criteria

- a. Each crew member shall participate as a crew member or a passenger in a fire fighting drill in a cabin environment involving at least one crew member and a passenger(s) and perform the following:
 - i. Recognize that there is a potential fire situation (e.g. smoke detector signal or unusual fumes, odours, etc.);
 - ii. Locate the source of fire;
 - iii. Apply communication and co-ordination procedures;
 - iv. Select, remove and operate the nearest appropriate fire extinguisher and other fire fighting equipment;
 - v. Control of passengers; and
 - vi. Monitor for re-ignition, and apply post-fire follow-up procedures

8.23.5 Possible Change to Current Regulatory Material

Training Affected

Conversion and Differences Training

Recurrent Training (3 yearly)

Proposed Guidance Material

It is proposed that consideration be given by UK CAA (and/or EASA) to providing guidance material to advise on the implementation of an integrated fire scenario during practical fire training. This should be performed in a cabin environment and encompass all firefighting procedures appropriate to the company procedures, which include (but are not limited to):

- a. Recognising that there is a potential fire situation (e.g. smoke detector signal or unusual fumes, odours, heat etc.);
- b. Locating the source of fire;
- c. Applying communication and co-ordination procedures with flight crew and other cabin crew (when applicable);
- d. Locating, removing and operating the nearest appropriate fire extinguisher and other firefighting and safety equipment;
- e. Control of passengers; and
- f. Monitoring for re-ignition, and applying post-fire follow-up procedures

8.23.6 Safety, economic and Environmental Impacts

Safety Impact

An integrated fire training scenario can provide cabin crew with a more realistic experience of carrying out in-flight firefighting procedures. It will give the opportunity for cabin crew to experience the different elements of the firefighting drill in context. Timing cabin crew performance during each scenario will emphasise the required need for urgent action (recommended in Section 8.24 – Guidelines for Training Methods in Emphasising the Required Urgency of Response to In-Flight Fires). It is very likely that implementing such training scenarios in a cabin environment would better prepare the cabin crew to deal with in-flight fires, compared to the current practice amongst the majority of operators and training organisations.

Economic Impact

The majority of operators/training organisations carried out separate training for different aspects of in-flight firefighting procedures. There might be various reasons for this; the primary reason would most likely be the unavailability of a training facility that enables the implementation of an integrated scenario. For operators/training organisations that have such a training facility, implementing an integrated fire scenario would most likely incur a minimal incremental cost. However; some operators/training organisations may find that implementing this concept would incur much higher incremental costs related to improving their training facility. Other costs involved would be due to amendment to Training Manuals and Operations Manuals.

There would be costs incurred to the authorities in developing the guidance material.

Environmental Impact

None identified.

8.23.7 **Summary**

Based on the findings from the review of current cabin crew fire training programmes, the online survey and the review of non-civil aviation training programmes, it is evident that implementing an integrated fire scenario in practical fire training will benefit cabin crew. It was also found that this subject is addressed in Transport Canada Civil Aviation regulatory material. Guidance material addressing the advantages of implementing an integrated fire training scenario would support the requirements and provide guidelines on the best practice in carrying out practical fire training scenarios.

8.24 **Guidelines for Training Methods in Emphasising the Required Urgency of Response to In-Flight Fires**

8.24.1 **Description of Issue**

The study found that the conduct of fire training did not adequately reflect the required urgency of response during an in-flight fire event. Consideration should be given to developing guidelines as to how this might be achieved.

8.24.2 **Scale of the Issue**

As mentioned in the FAA AC 120-80 (Reference 12), in-flight fires have featured in many fatal aircraft accidents. In fatal accidents involving in-flight fire, the time lapse between crew awareness of a fire situation to the time that the fire has become catastrophically uncontrollable was between seven and 35 minutes. For incidents involving hidden fires, an approximate estimate was that only one third of aircraft will reach an aerodrome before the fire became uncontrollable. It is therefore evident that the rapid actions of both cabin crew and flight crew in dealing with an in-flight fire is essential if continued safe flight is to be achieved.

The review of current cabin crew fire training programmes found that although the urgency of response was included and emphasised by most of the operators, examples of actual in-flight fires and the time available to the flight crew and the cabin crew to successfully deal with the fire situation were not always stressed (see Section 2.7).

In one case, the speed in donning PBE was timed on an individual basis using a stopwatch. Whilst this achieved a sense of urgency, the exercise still remained unrealistic as the PBE training units were fully ready to don and the neck seals were in a poor state (see Section 2.2.5).

Additionally, it was found that in some cases, the overall management of the fire training, and the ease in which most of the fires encountered in training were extinguished, may lead cabin crew to an incorrect assumption as to the seriousness of an actual in-flight fire situation.

The comments received from the online survey also indicated that the urgency of addressing an in-flight fire situation was not adequately emphasised during training (see Section 3.9):

"... Crew need to act immediately remaining calm but fighting and controlling the fire with urgency. In my opinion this is not really emphasised enough during a 3 day recurrent." (Cabin Crew)

"The issue that a cabin fire has to be discovered and dealt with ASAP is not reinforced." (Flight Crew)

"Too often cabin staff are unaware of the time-critical nature of this risk. It is often talked of in a joking manner." (Flight Crew – UK)

A respondent to the online survey suggested that practical training could include time constraints as a factor in tackling fire scenarios, in order to reinforce the need for urgent action in tackling an actual in-flight fire.

“When in training I feel we should be given a time allocation in which to put out or deal with the fire, during training crew tend to 'dilly dally' when putting on smokehoods I feel this is down to not feeling a full effect of a 'real' fire i.e. heat.” (Cabin Crew)

In addition, the evaluation of current cabin crew fire training programmes concluded that there was potential for better use of accident and incident data to reinforce the need for urgent firefighting action in-flight and this was suggested as a valuable contribution to theoretical crew training (see Section 2.7). Respondents to the online survey also identified the use of accident/incident data as a powerful theoretical training tool.

“Would like to have more discussion about real events and possibly see videos of true events...” (Cabin Crew)

“How about DVD documentaries with background information of real incidents? It would be interesting to see how a fire situation in midair occurs and develops. Investigating crew reaction and fire fighting techniques.” (Cabin Crew)

8.24.3 **Associated Current Regulatory Material**

INITIAL TRAINING – Appendix 1 to JAR-OPS 1.1005 (Amendment 13)

- (b) Fire and smoke training. An operator shall ensure that fire and smoke training includes:
 - (1) Emphasis on the responsibility of cabin crew to deal promptly with emergencies involving fire and smoke and, in particular, emphasis on the importance of identifying the actual source of the fire.

8.24.4 **Foreign Comparable Regulatory Material**

One of the evaluation criteria in TCCA Flight Attendant Training Standard (Reference 10) for Fire Fighting Drill is “responds in timely manner”.

In AC 120-80 Chapter 12 (Recommended Training), it was stated that:

- a. Training Programs. Certificate holders’ crewmember training programs should stress the importance of crewmembers taking immediate and aggressive action when confronted with in-flight fires...

Additionally, the US Federal Aviation Regulation Section 121.417 (Reference 11) requires:

- (b) Emergency training must provide the following:

- (4) Review and discussion of previous aircraft accidents and incidents pertaining to actual emergency situations.

8.24.5 Possible Change to Current Regulatory Material

Training Affected

Conversion and Differences Training

Recurrent Training (3-yearly)

Proposed Guidance Material

It is proposed that consideration be given by UK CAA (and/or EASA) to providing guidance material discussing various theoretical and practical training methods that can be implemented to reflect the required urgency of response during an in-flight fire event. This may include, but not be limited to:

- Featuring playback of videos or conducting a review of in-flight fire accidents or incidents during theoretical training, highlighting the time available for firefighting in fatal accidents. Use of data from Flight Data Recorders and Cockpit Voice Recorders may be of value in demonstrating the need for urgency of cabin crew response.
- Introducing timing of cabin crew response in fire training scenarios during practical fire training.
- Exposing cabin crew to real fires or providing cabin crew with a higher level of challenge during practical fire training, within the limits of Health & Safety regulations.
- Establishing an atmosphere/environment that could reflect the seriousness of an in-flight fire event through instructors' comments, instructions, and a rigorous approach to the conduct of the training.

8.24.6 Safety, economic and Environmental Impacts

Safety Impact

The methods listed in the proposed guidance material and any other form of psychological conditioning on this subject are likely to substantially improve cabin crew's preparedness to deal with an in-flight fire event with the required level of urgency. The majority of operators/training organisations could improve the effectiveness of their training by implementing the recommended methods.

Economic Impact

Some methods, e.g. timing the cabin crew's actions during fire training scenarios, would incur very minimal, if any, incremental costs to the operators/training organisations. Other methods, such as the video playback of accidents/incidents, may incur higher costs.

There would be costs incurred to the authorities in developing the guidance material.

Environmental Impact

None identified.

8.24.7 Summary

Findings from the review of current cabin crew fire training programmes and the online survey indicated that the required urgency of response in an in-flight fire event should be emphasised in training. Detailed guidance material specifying the methods by which this can be achieved in training will support the requirements and ensure that operators adopt the best practice in carrying out fire training.

9 Discussion and Conclusions

9.1 Fundamental Issues Identified in Current Cabin Crew Fire Training

Some of the training issues identified during the review of cabin crew fire training programmes might be considered as indicating non-compliance with JAR-OPS 1 requirements and might be resolved by greater regulatory oversight rather than by changes to the regulations. However, it is quite likely that the issues related to the high variability in the standard of fire training observed amongst the operators might be due to the lack of comprehensive requirements in JAR-OPS 1 and guidance material. This is also supported by the observation that most operators/training organisations provided more training than is required by JAR-OPS 1, especially in the case of Recurrent Training.

The wording of JAR-OPS 1 specifies that theoretical fire training should be conducted during Initial Training and practical fire training during Conversion and Differences Training and Recurrent Training. Most of the training improvements suggested in this study, for both theoretical and practical fire training, are proposed for inclusion in Conversion and Differences Training and Recurrent Training. The reasons for this were:

- Conducting theoretical training combined with practical training is considered more effective as it will add more relevance and focus.
- Recurrent Training should either include or repeat the requirements of Initial Training, since the important issues currently covered in Initial Training need to be dealt with on a recurrent basis rather than on a once only basis.
- Since many of the theoretical cabin crew firefighting training issues covered in Initial Training are actually aircraft-type related, transferring some of these items to Conversion and Differences Training in addition to repeating them in Recurrent Training would be a logical step.

The 3-years maximum recurrent fire training interval as set out in Appendix 1 to JAR-OPS 1.1015 (c) is considered acceptable as emphasis should be placed on the quality of the training, rather than the frequency of the training. Operators should be encouraged to establish a balance between training for the initial acquisition of the correct skills and knowledge and training for ensuring retention of those skills and knowledge.

Additionally, the objectives of the training, in terms of the key knowledge and skills that cabin crew must obtain in fire and smoke training, should be made clear to operators. This would help provide a clear direction on the training method and the equipment required to achieve the objectives. A forum, such as a periodic workshop or an internet-based forum, involving cabin crew fire instructors from airline and non-airline industry, would help in promoting best practice both formally and informally through networking.

Due to the high dependency on the cabin crew's capability in an in-flight fire event, the flight crew would expect the cabin crew to perform their duties to the highest level of competency and hence would expect the fire training and associated checking to be of a similar level to their training in dealing with emergencies. Therefore, individual performance is paramount and should be measured against a set of criteria with pass/fail qualification. In addition, considering that the quality of training depends heavily on the quality of instructors, there should also be standards for instructors.

Whilst the review of comparable US FAA and TCCA regulatory material played an important part in the evaluation of the proposed potential improvements, the actual implementation of the regulatory material in current practice cannot be confirmed in this study. The training requirements evaluated from the three regulatory authorities varied in many aspects that could complement each other, which suggested that consideration may need to be given to establishing international standards in cabin crew safety/emergency training requirements to achieve a common safety level in flight operations.

9.1.1 **The Assessment of Benefits and Costs**

An effort had been made to ascertain the relative priority of the proposed improvements discussed in Section 8, based on their assessed potential benefits and costs.

The assessment of potential benefits of improved training could only be carried out on a subjective basis since it is not feasible to assess the effect of enhanced cabin crew training in terms of accident prevention in a quantitative manner. Additionally, the assessment of potential costs of training improvements could only be somewhat subjective since there would appear to be a large variation in the standard of training undertaken, meaning that an accurate assessment of the potential incremental costs in improving training across the industry was difficult to perform. Some proposed training improvements may incur substantial costs to some operators and minor costs to others.

Due to these limitations, it is important that the assessment of benefits and costs do not detract from the actual importance of the issues raised in this study. Therefore, it is considered sensible to not include the relative priority of the proposed improvements based on the benefit/cost consideration.

INTENTIONALLY LEFT BLANK

Appendix 1 Survey Form

Cabin Crew Fire Training Survey

1. Introduction

1 / 4 25%

The objective of this survey is to obtain feedback from cabin crew, flight crew, instructors, and any interested parties as part of a cabin crew fire training needs analysis currently being carried out by RGW Cherry & Associates Ltd., for the **United Kingdom Civil Aviation Authority (UK CAA)**. The intent of the analysis is to review cabin crew fire training needs to ensure that cabin crew have the most appropriate training and procedures to deal with in-flight fires.

Although conducted for the UK CAA, we welcome international participation. The results will be published and will be available for safety standards consideration worldwide.

Your personal information will not be required. It should take no more than 10 minutes of your time to complete the survey. Your feedback is really important for this research; please answer as many questions as possible.

2. Background Information

2 / 4 50%

***1. I am:**

Cabin Crew
 Flight Crew
 Instructor
 Other (please specify)

2. If you are flight crew or cabin crew, what aircraft type(s) do you operate?

Please choose from the selection

Aircraft Type 1

Aircraft Type 2

Aircraft Type 3

If your aircraft type(s) is/are not on the list, please specify:

***3. Which country is the primary location of your organisation?**

3. Fire Training Issues

3 / 4 75%

***4. In your opinion, the amount of time spent on theoretical fire training is...**

- Too short
- Sufficient
- Too long
- I don't know

Please use this space below for any comment you may have on this subject

***5. In your opinion, the amount of time spent on practical fire training is...**

- Too short
- Sufficient
- Too long
- I don't know

Please use this space below for any comment you may have on this subject

***6. How frequent is your practical fire training?**

- Every year
- Every 2 years
- Every 3 years
- I don't know/Not applicable
- Other (please specify)

***7. Please indicate the degree to which you agree to the following statements:**

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	N/A
The fire training equips crew members to extinguish a fire behind the cabin panels.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The fire training equips crew members to extinguish any fire visible in the cabin.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The training for the management of passengers in the event of in-flight fire is adequate.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The time between <u>practical</u> fire training is such that crew members remember everything taught in the training within that period.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The fire training equips crew members to deal with multiple fires occurring at the same time.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please use this space below for any comment you may have on this subject

***8. Please indicate the degree to which you agree to the following statements on the realism of your practical fire training:**

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	N/A
The fire conditions experienced during training are realistic.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The equipment used in fire training is similar to the equipment on board the actual aircraft.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Firefighting scenarios carried out during training are relevant to aircraft operation.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The smoke conditions experienced during training are realistic.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Fire training is carried out in a facility sufficiently representative of an aircraft cabin.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please use this space below for any comment you may have on this subject

4. Operational Issues

4 / 4 100%

***9. I have:**

- Witnessed an in-flight fire
- Been involved in fighting an in-flight fire
- No experience with in-flight fire

If you have witnessed or been involved in fighting an in-flight fire, please briefly describe the fire (e.g. size, type, location, etc):

10. Please tick the appropriate box(es). If you have been involved in an in-flight fire, did you experience any problem in:

- Locating source of smoke/fire
- Locating and/or removing firefighting equipment
- Breaking the fire extinguisher seals
- Discharging the fire extinguisher
- Removing Protective Breathing Equipment from its packaging
- Using Protective Breathing Equipment
- Communicating with (other) cabin crew members
- Communicating with flight crew
- Management of passengers

If you have experienced any of the above, please use the text box below to indicate what you think might have caused the problem:

*** 11. Please indicate the degree to which you agree to the following statements:**

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	N/A
The procedures taught in fire training correspond to the procedures in crew operating manuals.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Procedures for communication and coordination between flight crew and cabin crew in the event of an in-flight fire are appropriate.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Procedures for communication and coordination between cabin crew in the event of an in-flight fire are appropriate.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please use this space below for any comment you may have on this subject

12. Please use the space below to indicate any deficiencies you believe exist in cabin crew fire training or areas where improvements might be made.

INTENTIONALLY LEFT BLANK

Appendix 2 Fire/Smoke Occurrence Severity

A methodology has been developed for assessing the severity of a fire/smoke occurrence based on the following factors:

- the degree to which the fire/smoke source could be identified and accessed
- the resultant fire intensity
- the resultant smoke intensity

For each occurrence, a score is given to each of these factors in accordance with the ratings shown in Table 1.

Table 1 Fire/Smoke Severity Rating

Fire Accessibility		Fire Intensity		Smoke Intensity	
Degree of Accessibility	Score	Degree of Accessibility	Score	Degree of Accessibility	Score
Easily Accessible	1	No Fire	0	No Smoke	0
Limited Accessibility (Action required)	2	Localised Light Burning/Charring of Material	1	Smell/No Visible Smoke	1
Not Accessible	3	Localised Moderate Burning (Fire damage to adjacent materials or components)	2	Light Smoke	2
Fire Location Unidentified by Crew	3	Localised Heavy Burning	3	Moderate Smoke	3
		Extensive Fire (hot enough to melt aircraft aluminium structure/skin)	4	Heavy Smoke	4

The fire/smoke severity of the occurrence may then be derived using the following equation:

$$\text{Severity Score} = (\text{Fire Accessibility Score})^2 + (\text{Fire Intensity Score})^2 + (\text{Smoke Intensity Score})^2$$

It may be seen that the resultant fire/smoke severity score will range from 2 to 41, where a score of 2 indicates a low severity occurrence and 41 indicates the highest possible severity score. In many instances, it is useful to group the occurrences into Severity Categories based on the magnitude of their severity score as illustrated in Table 2

Table 2 Occurrence Severity Category

Severity Score Range	Category
2 to 5	1
6 to 9	2
10 to 13	3
14 to 17	4
18 to 21	5
22 to 25	6
26 to 29	7
30 to 33	8
34 to 37	9
38 to 41	10

For the 316 Mandatory Occurrence Reports (MORs) analysed as part of this study the Severity Scores and Severity Categories were assessed. It must be stressed that the Severity Scores can only be considered as an approximate indication of the fire/smoke severity since they are based on assessments made from descriptions of the occurrence, and on many instances, the data were insufficiently detailed to make precise assessments. However, if the Severity Categories were reasonably accurate one might expect an inverse relationship between the occurrence categorisations and their frequency of occurrence. The results of these assessments are shown in Figure 1.

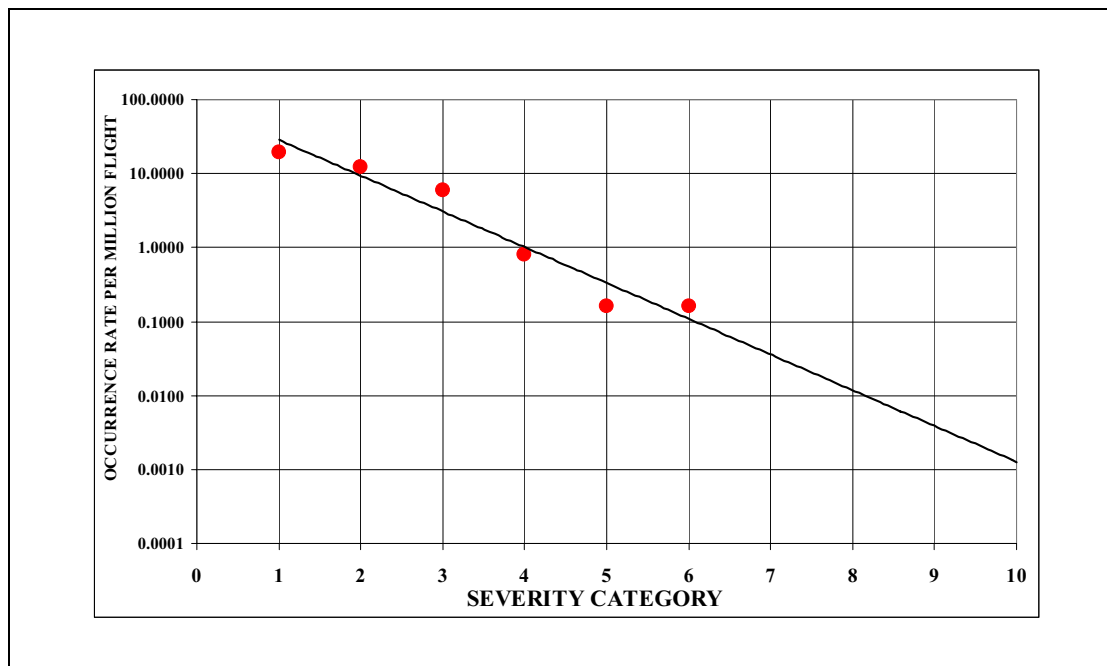


Figure 1 Severity v Frequency of Occurrence - All MOR Data

As may be seen from Figure 1 there appears to be a reasonable relationship between Severity Category and Frequency of Occurrence thus suggesting that the Severity Scoring gives a reasonable indication of the seriousness of the on-board fire/smoke occurrence.

Figure 2 is further evidence to suggest that the Severity Scoring system used gives a reasonable indication of the threat intensity. The graph shows that as the Severity Score in an occurrence there is a greater probability that the flight crew will divert or return to the departure airport.

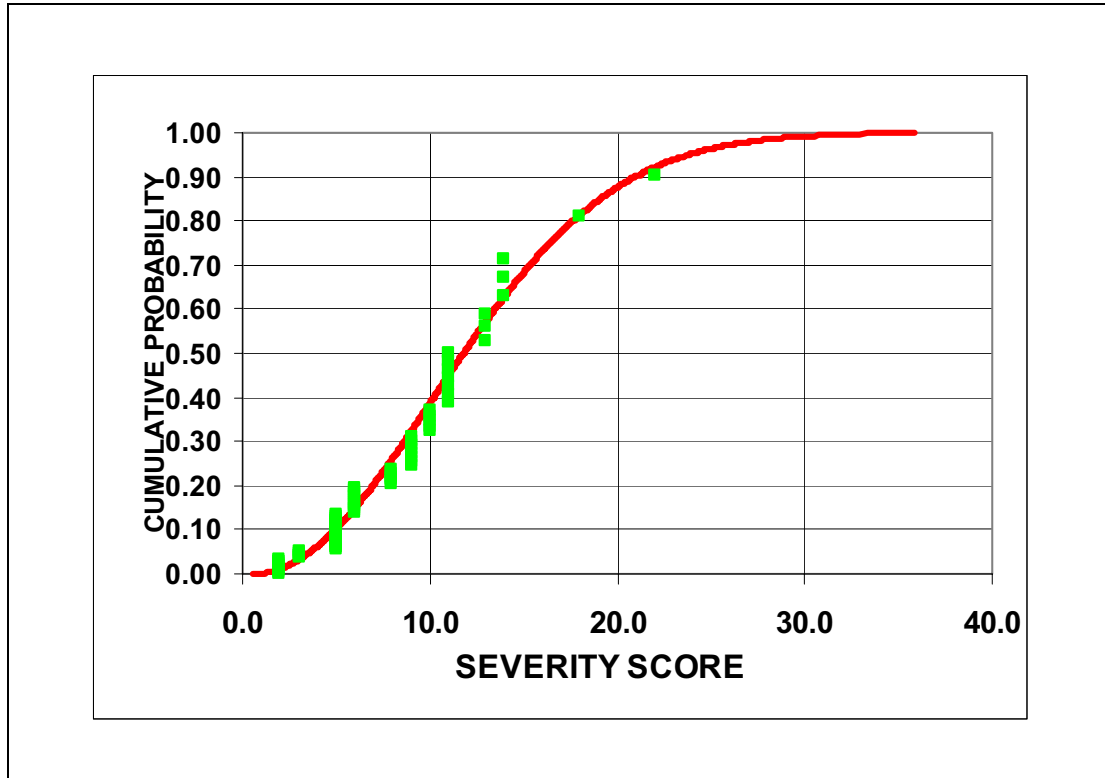


Figure 2 Cumulative Probability of a Diversion or Return to Departure Airport v Fire Severity Score - All MOR Data

Therefore, it is concluded that based on the relationships illustrated in Figure 1 and Figure 2 the Severity Scoring system provides a reasonable representation of the threat intensity. However, it is considered that the algorithm for deriving the Severity Score could be developed further to give a more accurate assessment of the magnitude of the threat from hidden fires.

INTENTIONALLY LEFT BLANK

Appendix 3 Relevant Accidents, Incidents and Recommendations

Contained in this Appendix are Accident and Incident Data and Recommendations, published by Accident Investigating Authorities and other reputable sources, pertinent to in-flight occurrences that were identified in this study.

Table 1 Accident Data

Date	Aircraft Type	Resumé	Issues relating to Cabin Crew In-flight Fire Fighting
11-Sep-68	CARAVELLE III	(A fire in the rear of the cabin, some 21 minutes after takeoff. An emergency was declared, but the Caravelle crashed into the sea off Nice. The fire is thought to have been started in the right lavatory and galley area.) Source: Aviation Safety Network	Data regarding any in-flight fire fighting that may have taken place were unavailable at the time of report preparation.
26-Jul-69	CARAVELLE	An intense in-flight fire in the forward vestibule area caused the crew to make a successful emergency landing in the dark in open country. Emergency exits were opened before touchdown; 2 passengers exited from these but unfortunately were ingested by the engines. It is assumed that due to the intense fire the remaining passengers were unable to evacuate.	Data regarding any in-flight fire fighting that may have taken place were unavailable at the time of report preparation.
08-Aug-71	VISCOUNT 745D	On 08-Aug-1971, a Aloha Airlines Flight 845, a Vickers Viscount 745D, registered as N7415, had an interior cabin fire after landing at Honolulu and during taxi to the terminal. After the flight landed at Honolulu and following her arrival announcement, the stewardess observed smoke midway in the cabin and immediately informed the captain. The presence of smoke was confirmed and the captain immediately stopped the aircraft and notified the control tower that he had a fire aboard. The forward passenger door was opened and the passengers were ordered to deplane. The aircraft interior was severely damaged by fire, heat, and smoke. The most severe fire and heat damage existed in the passenger compartment in the vicinity of seat row 4. The area below seat 4B had a hole about 21 by 31 inches burned through the wood floor. That portion of the aileron, elevator and rudder control push rods (approximately 16 inches) located about 111/2 inches above the left battery had melted away, as did three floor support stringers. The probable cause of this accident was an undetected electrical short within the left nickel-cadmium aircraft battery. Smoke or fumes originating in the batteries during flight would dump overboard through normal air circulation and the odour would not enter the cockpit until after the aircraft had landed and the cabin pressurisation system spill valves were opened.	There was no in-flight firefighting since the fire did not become evident until the aircraft was on the ground.

Table 1 Accident Data (Continued)

Date	Aircraft Type	Résumé	Issues relating to Cabin Crew In-flight Fire Fighting
11-Jul-73	B707-321C	<p>On 11-Jul-1973 a Varig B707 registered as PP-VJZ was descending to Orly, near Paris, France. The aircraft reported a problem with fire on board and requested an emergency descent. This request followed a report by cabin personnel of smoke in the rear of the passenger cabin. In reply to a request by control, the pilot reported total fire which was prompted by the alarming announcement of the chief steward, who stated that the situation was becoming more and more serious, that smoke had invaded the cabin and that passengers were being asphyxiated. At about this time smoke was smelled in the cockpit. The crew members put on oxygen masks and anti smoke goggles but there was so much black smoke in the cockpit that the pilot could no longer see the instruments and the side windows were therefore opened. The captain then decided that, in view of the untenable situation, a forced landing was necessary. This was carried out with the pilots looking at the ground through the side windows. Although the cabin crew quickly used extinguishers, this was not effective because the source of the fire was never located.</p> <p>The rapid sequence of events prompted the flight crew to partly implement various procedures in succession which, since they involved different hypotheses, were not really coherent. Nevertheless, the actions of the flight crew were sound.</p>	<p>Recommendations were issued by the Commission D'Enquete France for Accident Reference 19730711 relating to Communication/ Coordination with Flight Crew and training related to the dangers of cabin fires and on the importance of rapid action fire fighting in a smoke-filled atmosphere. These are contained in the Recommendations section of this Appendix.</p>
07-Sep-76	DC 3	<p>{A fire in the lavatory was discovered and an emergency descent from FL 120 was carried out. The aircraft landed safely in a stubble field, but the aircraft was destroyed by fire.} Source: Aviation Safety Network</p>	<p>Data regarding any in-flight fire-fighting that may have taken place were unavailable at the time of report preparation.</p>

Table 1 Accident Data (Continued)

Date	Aircraft Type	Resumé	Issues relating to Cabin Crew In-flight Fire Fighting
26-Nov-79	B707-340C	<p>On 26-Nov-1979, a Pakistan International Airlines (PIA) Boeing B707-300, registered as AP-AWZ, struck the ground while attempting to return to Jeddah Airport, Saudi Arabia. The aircraft was destroyed. There were 11 crewmembers and 145 passengers aboard and all suffered fatal injuries. At 0105 hours, 21 minutes after take-off the flight crew reported smoke in the cockpit coming from the cabin area. They requested and received ATC clearance to return to Jeddah and to leave their cruising level. An emergency descent was executed while attempting to return to Jeddah. The aircraft struck the ground in a level rocky area at 3300 ft, exploded and burned. An inflight fire started in the aft cabin and rapidly spread throughout the aircraft. The origin of the fire was not determined. Incorrect emergency and smoke evacuation procedures were carried out and smoke incapacitated the flight crew.</p> <p>FURTHER INFORMATION FROM AVIATION SAFETY NETWORK: Flight PK740 departed Jeddah at 01:29 for a flight to Karachi. The aircraft was climbing to FL370 when, at 01:47, a stewardess reported a fire near the aft cabin passenger door. The crew started a descent from FL300 and were cleared to descend to 4000 feet. Following a mayday call at 02:03 nothing more was heard from the flight. PROBABLE CAUSE: "An in-flight fire in the cabin area which, through its intensity and rapid extension, resulted in panic among the passengers and smoke in the cockpit, eventually incapacitating the flight crew. The cause of the cabin fire was not determined." It was considered that the origin of the cabin fire could have been a leaking gasoline or kerosene stove, carried aboard by Haj pilgrim passengers. Pressure differential could have caused a poorly sealed gasket to leak fuel. A second possibility is an electrical fire, but the rapid extension of the fire was considered difficult to explain because of the electrical circuit protection devices of the Boeing 707. Sabotage was considered as another possibility, but no evidence of use of an incendiary device was found.</p>	<p>Data regarding any in-flight fire-fighting that may have taken place were unavailable at the time of report preparation.</p>

Table 1 Accident Data (Continued)

Date	Aircraft Type	Resumé	Issues relating to Cabin Crew In-flight Fire Fighting
19-Aug-80	L1011	<p>On 19-Aug-1980 a Saudia L1011 registered as HZ-AHK was taking off from Riyadh airport. Seven minutes after take-off an aural warning indicated smoke in the aft cargo compartment. When the aircraft landed back at Riyadh, some 20 minutes later, the fire had penetrated into the cabin. The aircraft did not make an emergency stop but instead taxied off the runway and shut down the engines. An evacuation was never initiated. All 301 on board perished in the fire. A fire developed in the C3 cargo compartment inflight. Nineteen minutes after the flight engineer notified the captain of fire on board, the aircraft came to a stop on the runway. After it stopped on the taxiway, a witness observed a fire through the windows on the left side of the cabin between the L3 and L4 doors. This witness said there was no fire outside the aircraft at this time. Three minutes 15 seconds after the aircraft stopped the engines were shut down, smoke rose from the top of the fuselage, followed almost immediately by flames. The burnthrough of the cabin floor structure was localised beneath the 2nd through 6th row of dual seat units forward of L4. The evacuation procedure was not started. The captain, by allowing the engines to continue to operate after he stopped the aircraft, effectively prevented the cabin crew from initiating the evacuation on their own. The environmental control system packs were shut down before the engines were shut down, resulting in loss of any ventilation air introduced within the fuselage.</p>	<p>Data regarding any in-flight fire-fighting that may have taken place were unavailable at the time of report preparation.</p>

Table 1 Accident Data (Continued)

Date	Aircraft Type	Résumé	Issues relating to Cabin Crew In-flight Fire Fighting
21-Feb-82	DHC6	<p>On 21-Feb-1982 a Pilgrim Airlines flight 458 de Havilland DHC-6-100, registered as N127PM, was at 4,000 ft when a fire started after operation of the windshield washer/deicer system. The aircraft landed on a frozen lake but was destroyed by fire. [There were no cabin crew on board.] There were 2 flightcrew and 10 passengers on board the aircraft. Both flightcrew were seriously injured. 1 passenger suffered fatal injuries, 8 passengers received serious injuries, and 1 passenger sustained minor injuries. The initial indication of fire was the presence of light grey-white smoke in the cockpit that occurred shortly after the first officer activated the windshield deicing system and smelled alcohol. Within seconds, the grey smoke thickened to black, boiling smoke, and flames broke out in the cockpit and just behind the cockpit/cabin bulkhead on the left side of the forward Cabin. The aircraft was equipped with two portable fire extinguishers. The cockpit extinguisher was mounted behind the copilot's seat on the cockpit/cabin bulkhead. The cabin extinguisher was accessible under the left-side passenger seat on the aft bulkhead. The cabin extinguisher was accessible only by a person kneeling on the floor and reaching under the seat to release it from its mounts. The cabin extinguisher was not visible when the seat was occupied. The pre-takeoff briefings included the sentence: "There are two fire extinguishers; one under [sic] the right pilot's seat and the other under the left rear-most seat of your cabin." The seatback "Emergency Procedures" safety briefing cards in the cabin showed the location of the fire extinguisher at the right cockpit seat, but did not show the location of the fire extinguisher located under the rear-most left seat. The first officer said that he attempted to use the fire extinguisher behind his seat but that it was too hot to touch. No one attempted to use the fire extinguisher in the cabin. A passenger attempted to put out the fire by covering it with a coat and broke several cabin windows in an effort to clear the smoke.</p>	<p>There were no dedicated cabin crew on board this accident aircraft however the occurrence has been included due to the difficulties that were encountered in accessing the fire extinguishers.</p>

Table 1 Accident Data (Continued)

Date	Aircraft Type	Resumé	Issues relating to Cabin Crew In-flight Fire Fighting
02-Jun-83	DC9-32	<p>On 2-Jun-1983 Air Canada DC9-32 registered as C-FTLU was flying from Dallas to Montreal. While en route at 33,000 feet, the cabin crew discovered a hidden fire in the aft lavatory. After attempting to extinguish it an emergency descent and landing was made to Greater Cincinnati International Airport. After the subsequent evacuation a flash fire occurred within the cabin. Of the 5 crew and 41 passengers, 23 passengers were not able to get out of the aircraft and died in the fire. [The fire] had burned undetected for almost 15 minutes before the smoke was first noticed. The smoke in the aft lavatory was discovered by a flight attendant. The smoke was reported to the captain as a fire. The source of the smoke was never identified either by the flight attendants or the first officer. The captain was never told nor did he inquire as to the precise location and extent of the "fire," which had been reported to him. Crewmember reports that the fire was abating misled the captain about the fire severity and he delayed his decision to declare an emergency and descend. The delayed decision to descend and land contributed to the severity of the accident. The flight attendants' passing out wet towels to the passengers and instructing them to breathe through the towels or through articles of clothing aided in the survival of some of the passengers. During the descent, some passengers received evacuation instructions from the flight attendants. Several passengers said that when the flight attendants were walking down the aisles checking seat belts, it would have been impossible to read the briefing cards at that time due to smoke. [From NTSB Safety Recommendations, In-Flight Fires]: In its final report, the Safety Board determined that the flight attendant's discharge of fire extinguishing agent into the lavatory had little or no effect on the fire, noting that [i]n order for the extinguishing agent to be effective, it must be applied to the base of the flames.</p>	<p>Recommendations were issued by the NTSB including those relating to AFM procedures for the control and removal of smoke, review of flight and cabin crew fire fighting procedures, flight/cabin crew communication and access to hidden fires. These are contained in the Recommendations section of this Appendix.</p>
05-Sep-93	B727-200	<p>{The smoke alarm for the aft right hand lavatory activated, associated by a smell of overheating electrical wiring near the lavatory. The aircraft landed safely at Santo Domingo and taxied to stand A6, [where] normal passenger disembarkation took place. The cabin then suddenly filled with smoke and the remaining passengers were evacuated. A major fire developed and destroyed the aircraft.}</p> <p>Source: Aviation Safety Network</p>	<p>Data regarding any in-flight fire-fighting that may have taken place were unavailable at the time of report preparation.</p>

Table 1 Accident Data (Continued)

Date	Aircraft Type	Resumé	Issues relating to Cabin Crew In-flight Fire Fighting
17-Oct-93	MD80	<p>Ten minutes after takeoff from Munich, while passing FL180, the crew smelled something abnormal. A few moments later, increasingly dense smoke became noticeable in the area of the overhead panel. The flightcrew declared an emergency and decided to return to Munich. The "Electrical Smoke in Cockpit" checklist did not provide guidance on how to identify the origin of the smoke or how to isolate the source of the fire. Because the smoke was rapidly thickening, the crew was unable to read and complete the checklist. After declaring an emergency, the aircraft received radar guidance by approach control to land at Munich. The flightcrew reported that crew coordination became difficult and that the captain's flight instruments began to fail sporadically. The flightcrew further reported that visibility in the cockpit became extremely limited. The investigation found that the flightcrew did not take timely or appropriate actions to eliminate smoke from the cockpit.</p> <p>Initially, the flightcrew did not depressurize the cabin which prevented the opening of the cockpit window. After switching the cabin pressurization system to "manual," the flightcrew reported that they were too preoccupied with flying and preparing to land the airplane to open the window.</p> <p>The investigation of the incident found indications of a smouldering fire in the overhead electrical panel. Electrical wires, terminal blocks, and the emergency power switch, Part Number (P/N) 103-200, were charred or burnt. The direction of the propagation of the smoke and fire indicated that the fire had originated in the area of the emergency power switch.</p> <p>Source: Aviation Safety Network</p>	<p>Data regarding any in-flight fire-fighting that may have taken place were unavailable at the time of report preparation.</p>

Table 1 Accident Data (Continued)

Date	Aircraft Type	Resumé	Issues relating to Cabin Crew In-flight Fire Fighting
24-Nov-93	MD 87	<p>On 24-Nov-1993 an SAS MD-87 registered as SE-DIB was taxiing at Copenhagen Airport Kastrup (EKCH), Denmark. The CA2 cabin attendant, who was positioned in the aftmost part of the cabin observed an electrical fire in the area of the aft lavatory. The passengers were disembarked without delay. The aircraft suffered considerable fire and heat damage. There were 6 crew and 79 passengers on board. All crew and passengers escaped with no injuries. The smoke developed shortly after touchdown, while the aircraft was taxiing towards the assigned gate. After docking, when the forward and aft cabin doors were opened, the smoke intensified and a fierce fire erupted resulting in severe structural and interior damage. During the last part of the disembarkation the smoke alarm sounded at least twice, probably triggered by the intense smoke development in the right-hand aft lavatory. The smoke alarm was misinterpreted as being the evacuation signal - activated by the cockpit crew - by at least one cabin crew member. Neither the cabin nor the cockpit crew made any attempt to fight the origin of smoke/fire, but concentrated on helping the passengers safely out of the aircraft. The investigation revealed that the crew would not have been able to reach and effectively fight the fire considering the place of heat. When the captain wanted to inspect the cabin, he attempted to use one of the five available smoke hoods but encountered such difficulties in opening and unfolding the vacuum-packed plastic package that he abandoned the use of the smoke hood and carried out the inspection without any protective devices. Later investigation revealed that factory installed wiring had been pinched and chafed, which led to arcing and ignition of the cabin sidewall insulation material.</p>	<p>Whilst this was not an in-flight fire occurrence it has been included in this Appendix since it is evident that Cabin Crew Communications and the use of Protective Breathing Equipment were issues during and after passenger disembarkation.</p>

Table 1 Accident Data (Continued)

Date	Aircraft Type	Résumé	Issues relating to Cabin Crew In-flight Fire Fighting
02-Sep-98	MD 11	<p>On 2 Sept 98, IJMD-11, reg. HB-IJWFI Swissair Flt 111 departed New York to Geneva, with 215 passengers and 14 crew. About 53 mins after departure, the flight crew smelled an abnormal odour in the cockpit. The flight crew declared an emergency and indicated a need to land. The aircraft crashed into the ocean about five nautical miles southwest of Peggy's Cove, Nova Scotia, Canada. The aircraft was destroyed and there were no survivors. An evaluation of the available information indicates that the fire likely started within the confines of a relatively small area above the right rear cockpit ceiling just forward of the cockpit rear wall near STA 383. Support for the fire initiating and spreading from this localized area includes the following:</p> <ul style="list-style-type: none"> -The presence of electrical wires as potential ignition sources and easily ignited MPET-covered insulation blanket material; -The known environmental conditions in the cockpit and cabin; -The time frame in which the fire propagated from initial detection until the fire-related failures of various aircraft systems occurred; -The air-flow patterns; and -The fire and heat-damage patterns. <p>Findings: 8. There was a reliance on sight and smell to detect and differentiate between odour or smoke from different potential sources. This reliance resulted in the misidentification of the initial odour and smoke as originating from an air conditioning source.</p> <p>9. There was no integrated in-flight firefighting plan in place for the accident aircraft, nor was such a plan required by regulation. Therefore, the aircraft crew did not have procedures or training directing them to aggressively attempt to locate and eliminate the source of the smoke, and to expedite their preparations for a possible emergency landing. In the absence of such a firefighting plan, they concentrated on preparing the aircraft for the diversion and landing.</p>	<p>Recommendations were issued by TSB Canada following their investigation into this accident. In particular A00-16, 17 & 20 relating to Communication/Coordination amongst crew and locating and accessing the source of fire/smoke. These are contained in the Recommendations section of this Appendix.</p>

Table 1 Accident Data (Continued)

Date	Aircraft Type	Resumé	Issues relating to Cabin Crew In-flight Fire Fighting
24-Aug-99	MD 90	<p>At 12:36 on August 24 1999, local time an MD-90-30, had just landed and was rolling on Runway 21 at the Hualien Airport, when an explosion was heard in the front section of the passenger cabin, followed by smoke and then fire. The pilot immediately braked [and] brought the aircraft to a stop on the runway. The co-pilot, carrying a flashlight and fire extinguisher, then rushed to extinguish the fire with the assistance of the L1 flight attendant. Their effort was unsuccessful as thick smoke kept them from entering into the main cabin. 90 passengers plus the crew of 6 was safely evacuated. Casualties included 14 seriously wounded passengers and another 14 that suffered minor injuries.</p> <p>Probable Cause: A flammable liquid (gasoline) inside bleach and softener bottles and sealed with silicone was carried on board the aircraft. A combustible vapor formed as the leaking gasoline filled the stowage bin, and the impact of the landing aircraft created a short in a battery. The short ignited the gasoline vapor and created the explosion.</p>	<p>This was not an in-flight fire accident however it is included in this Appendix for completeness since it may have been had circumstances been different.</p>

Table 1 Accident Data (Continued)

Date	Aircraft Type	Resumé	Issues relating to Cabin Crew In-flight Fire Fighting
17-Sep-99	MD 88	<p>On September 17, 1999, a McDonnell Douglas MD-88 operated by Delta Air Lines experienced an in-flight fire and made an emergency landing at Cincinnati and Northern Kentucky International Airport, Covington, Kentucky. The airplane sustained minor damage. There were no injuries to the 2 flight crewmembers, 3 flight attendants, 3 off-duty flight attendants, and 113 passengers during the evacuation.</p> <p>On departure climb, the flight attendants smelled something burning. Then a passenger noticed a 'glow' in the right side air vent near his feet and reported that the cabin floor was warm. A flickering red glow was observed coming from the floor vent. While one flight attendant went to the cockpit to notify the captain what had been seen, another flight attendant sprayed the contents of a halon fire extinguisher into the vent, after which the red glow disappeared. The pilot declared an emergency and returned to the departure airport. The airplane was stopped on the runway and based upon reports from emergency personnel, an emergency evacuation was performed. A 5-foot by 5-foot area of insulation, which consisted of fiberglass, covered on both sides with a metallized mylar, was burned.</p> <p>[Taken from FAA Safety Recommendations, In-flight fires]: Flight attendant No. 1 went to the cockpit to inform the flight crew of these observations and asked the captain whether to spray Halon into the vent where she had seen the glow. The captain instructed her not to use the Halon extinguisher, indicating he was concerned about spraying Halon in the cabin. Meanwhile, another flight attendant had already discharged a Halon fire extinguisher into the vent and observed that the glow was no longer visible. Thereafter, the smoke began to dissipate and did not return, indicating that the fire had been extinguished by the Halon. When flight attendant No. 1 returned from the flight deck, she became alarmed that a Halon fire extinguisher had been discharged because the captain had instructed her not to do so.</p>	<p>Recommendations were made by the NTSB following their investigation into this incident (Recommendation Nos. A-01-083 to 087). In particular, those relating to crewmembers' training programmes being carried out in accord with FAA Advisory Circular 120-80 and recurrent training on locating and accessing fires. These are contained in the Recommendations section of this Appendix.</p>

Table 1 Accident Data (Continued)

Date	Aircraft Type	Resumé	Issues relating to Cabin Crew In-flight Fire Fighting
08-Aug-00	DC9 30	<p>On August 8, 2000, a McDonnell Douglas DC-9-32 operated by Air Tran Airways as flight 913, experienced an in-flight fire and made an emergency landing at Greensboro Piedmont-Triad International Airport, Greensboro, North Carolina. The airplane was substantially damaged from the effects of fire, heat, and smoke. Of the 57 passengers and 5 crewmembers on board, 3 crewmembers and 2 passengers received minor injuries from smoke inhalation, and 8 other passengers received minor injuries during the evacuation.</p> <p>A smell of smoke was noticed on the flightdeck shortly after takeoff from Greensboro. The smoke became very dense and restricted the crew's ability to see both the cockpit instruments and the visual references outside the airplane. The cabin crew noticed a smell of smoke, followed by a visual sighting of smoke and sparks in the area of the forward flight attendant jumpseat. The Board's initial investigation found extensive heat damage to wires and insulation in the electrical panel behind the captain's seat. The heat was sufficient to blister the primer on the fuselage crown skin.</p> <p>The Safety Board also learned during its investigation of this accident that neither flight attendant on board flight 913 attempted to locate the source of the smoke in the cabin or to use any of the firefighting equipment available to them. It was also learned that AirTran's flight attendant training program does not include any drill involving hidden fires but does include a drill that uses a visible, open flame. Based on this accident (and others involving in-flight fires), the Safety Board issued five safety recommendations to the FAA on January 4, 2002*, regarding improved crewmember training for fighting in-flight fires. The Safety Board's investigation also revealed that after donning his oxygen mask, the first officer removed it to address the passengers on the public address system, exposing himself to the smoke and the potential for incapacitation. He reported in a post accident interview that he continued to feel the effects of the smoke after he replaced his mask.</p> <p>[Taken from FAA Safety Recommendations - In Flight Fires]: Shortly after takeoff, flight attendants No. 1 and No. 2, who were seated on the forward jumpseat, both smelled smoke. Flight attendant No. 1 went to the cockpit, where she saw smoke everywhere and noticed that the crew had donned their oxygen masks. The captain told her that they were returning to Greensboro. She closed the cockpit door and returned to the cabin. She and flight attendant No. 2 resealed themselves in empty seats in business class because of the rapidly accumulating smoke in the galley area around their jumpseats.</p>	<p>Issues associated with this accident include communication between flight and cabin crew, locating and accessing the source of fire/smoke, and the use of fire extinguishers.</p> <p>* For details of these recommendations, A-01-83 to A-01-87 inclusive, see the Recommendations section of this Appendix.</p>

Table 1 Accident Data (Continued)

Date	Aircraft Type	Resumé	Issues relating to Cabin Crew In-flight Fire Fighting
21-Sep-00	B707	<p>Flight attendant No. 1 reported that the smoke became so dense she could no longer see the forward galley. However, neither flight attendant made any effort to locate the source of the smoke or to use any of the firefighting equipment available to them. Flight attendant No. 1 saw a large amount of electrical arcing and sparking and heard popping noises at the front of the cabin. She told investigators that she debated whether to use the Halon fire extinguisher but was unsure where to aim it. She decided not to use the Halon fire extinguisher because she did not see a fire to fight. An off-duty AirTran pilot seated in first class considered using a Halon fire extinguisher but decided against it because he was concerned that the Halon "would take away more oxygen."</p> <p>[On 21 Sept 2000] Togo's presidential Boeing 707 plane was returning from to Lomé, via Paris, after dropping off the chorus of the Université de Bénin-Togo in Valencia, Spain. When the plane was 200 km from the Niger capital, a fire broke out in the cockpit, and the crew radioed for permission to make an emergency landing in Niamey. Reports we received from residents said that the plane flew over the city at an altitude of barely 65 meters, with smoke billowing from the aircraft. An emergency belly landing was carried out at the Hamani Diori International Airport. A fire erupted and destroyed the plane. A short circuit is said to have caused the fire. [There were no fatalities among the 8 crew and 2 passengers.] Source: Aviation Safety Network</p>	Data regarding any in-flight fire-fighting that may have taken place were unavailable at the time of report preparation.

Table 1 Accident Data (Continued)

Date	Aircraft Type	Resumé	Issues relating to Cabin Crew In-flight Fire Fighting
29-Nov-00	DC9-30	<p>On November 29, 2000, DC-9-32, N826AT, executed an emergency landing at Hartsfield Atlanta International Airport (ATL), Atlanta, Georgia. Shortly after takeoff, the flight crew observed that several circuit breakers had tripped and several annunciator panel lights had illuminated. Subsequently, about 2 minutes after takeoff, the flight crew requested a return to ATL. After the landing, one of the flight attendants reported to the flight crew that smoke could be seen emanating from the left sidewall in the forward cabin; air traffic control (ATC) personnel also notified the flight crew that smoke was coming from the airplane. The flight crew then initiated an emergency evacuation on one of the taxiways. Of the 2 flight crewmembers, 3 flight attendants, and 92 passengers on board, 13 passengers received minor injuries. The airplane sustained substantial damage. The captain stated that there was no visible smoke or smell of smoke in the cockpit before landing. About 1550, the airplane landed on runway 26R. The captain stated that the landing and rollout were normal. During the airplane's exit from the runway onto taxiway B-3, the lead flight attendant opened the cockpit door and announced that there was smoke in the cabin. A short time later, the lead flight attendant again opened the cockpit door and reported that the amount of smoke in the cabin had increased and asked the captain if he wanted to evacuate. The captain stated that he set the brakes and told the lead flight attendant that they would evacuate and that he would make an announcement to the passengers. However, the public address system had become inoperative, and the emergency evacuation commenced with the flight attendants making announcements to the passengers and directing the evacuation. The captain stated that the first officer completed the emergency evacuation checklist and exited the airplane. The captain then donned protective breathing equipment and proceeded through the cabin looking for any incapacitated passengers. He reported that the visibility in the first class cabin was about 1 to 2 feet. He stated that he proceeded to the rear of the airplane to check the lavatories, at which time, he found the No. 3 flight attendant leaving with the last passenger.</p>	<p>Whilst limited data are available on any attempts at firefighting that may have taken place in flight it would appear that the source of the fire was not located prior to the aircraft being on the ground.</p>

Table 1 Accident Data (Continued)

Date	Aircraft Type	Resumé	Issues relating to Cabin Crew In-flight Fire Fighting
29-Nov-00	DC9-82, N3507A	<p>On November 29, 2000 a DC-9-82 (MD-80), N3507A, sustained minor damage from an in-flight fire that began shortly after takeoff. The 2 certificated airline transport pilots, 3 flight attendants and 61 passengers were not injured. During initial climb-out, the airplane was struck by lightning. Shortly thereafter, dark smoke entered the forward area of the passenger cabin. The crew declared an emergency, and the flight attendants, with a passenger's assistance, cut a hole in the overhead panel, and discharged the contents of two hand held fire extinguishers. The airplane landed uneventfully and an emergency evacuation was conducted without incident.</p> <p>After takeoff, the three flight attendants saw a flash of light and heard a boom on the right side of the airplane. Flight attendant No. 1, who was seated on the forward jumpseat, saw white smoke coming from a fluorescent light fixture in the forward entry area. She shut the light off and called the cockpit. The captain told her to pull the breaker for the fluorescent light. She pulled the circuit breaker, and smoke stopped coming out of the fixture. When flight attendant No. 1 went aft to check on the passengers, she observed dark, dense, black smoke coming from the ceiling panels above rows 7 and 8. She went to the cockpit and notified the flight crew while the other two flight attendants retrieved Halon fire extinguishers and brought them to the area near rows 7 and 8. The smoke detectors in the aft lavatories sounded. The smoke worsened in the midcabin area, and a ceiling panel above row 9 began to blister and turn yellow. A flight attendant began discharging a Halon extinguisher toward the blistered ceiling panel. Flight attendant No. 1 asked the passengers if anyone had a knife that could be used to cut the ceiling panel. A passenger produced a knife and cut a circular hole in the blistered area of the ceiling panel. Flight attendant No. 1 then fully discharged a Halon fire extinguisher into the hole, assessed the results, and found that the smoke appeared to be diminishing. Before taking her seat for the emergency landing, another flight attendant gave the passenger in seat 9E a Halon fire extinguisher, instructed him on its use, and told him to use it if it was needed. However, the smoke did not recur.</p>	<p>Difficulties were encountered in locating and accessing the source of the fire/smoke.</p>

Table 1 Accident Data (Continued)

Date	Aircraft Type	Resumé	Issues relating to Cabin Crew In-flight Fire Fighting
15-Dec-06	B737-824	<p>On December 15, 2006, a Boeing 737-824 made an emergency landing at Colorado Springs Municipal Airport (COS), Colorado Springs, Colorado, after the cabin crew reported an in-flight fire. According to the passenger who was seated in 23B (middle), the passenger seated in 23A (window) was wearing an air purifier device around his neck. He yelled and flung the air purifier device that was around his neck because it had started to burn him. The device exploded into a ball of flames about the size of volleyball and dropped between us in the seats. A flight attendant sprayed the seats with a fire extinguisher. The lead flight attendant heard a noise and saw a flash of light, "lighting up everything in front of her." Seeing smoke coming from seats 23A and B, she rushed aft and told the aisle flight attendant there was a fire and to grab a fire extinguisher. The device was sent to NTSB's headquarters for examination. According to the Fire and Explosion Specialist's report, "The unit originally came with a 3.6V CR123A size non-rechargeable lithium primary battery. A kit containing a charger and a rechargeable lithium-ion battery was also available for this unit." "The battery compartment was melted and deformed at the top portion near the clasp. The cover had two areas of metal splatter. Similar material was found along the edges of the battery compartment as well. An EDS [Energy Dispersive Spectroscopy] analysis of this splatter found the presence of manganese in the splatter material. Manganese dioxide is a component in primary lithium batteries. The specialist's report noted that in testimony given at NTSB public hearings on the hazards associated with primary and secondary lithium batteries, a short circuit was the most common cause of battery fires. The short circuit can be caused either by design flaws, manufacturing defects or improper packaging and handling. Charging non-rechargeable batteries can result in an internal short that can lead to thermal runaway and battery failure. Batteries are generally not designed to be able to contain catastrophic failures, and when they go into thermal runaway they often explode and expel their contents to the environment potentially causing ignition in areas well beyond the initiating battery cell."</p>	See the Section regarding Future Threats in the main body of the Report

Table 2 Recommendations

Recommendation	Investigating Authority	Recommendation Number	Accident/Incident	Status
Finally the Investigation Commission stresses the need for a reliable communication system and efficient operating instructions for the rapid transmission of safety communications between the flight crew and cabin personnel and vice versa, especially in wide-bodied aircraft. [ICAO Circular 132-AN/93]	Commission D'Enquete France	No Recommendation Number	Orly, B707, 11/07/1973	Unknown
Instructions to personnel on the dangers of cabin fires, even limited ones, and on the importance to act on the fire itself without delay, and training for this personnel in fire fighting and emergency procedures in a smoke-filled atmosphere. [ICAO Circular 132-AN/93]	Commission D'Enquete France	9	Orly, B707, 11/07/1973	Unknown
The NTSB recommends that the FAA: evaluate and change as necessary the procedures contained in the FAA-approved Airplane Flight Manuals (AFM) of transport category airplanes relating to the control and removal of smoke to assure that these procedures address a continuing smoke source and are explicit with regard to the presence of fire and the optimum use of cabin pressurization and air conditioning systems.	NTSB	Rec #: A-83-077	Cincinnati 02/06/1983 DC-9,	Closed - Acceptable Action

Table 2 Recommendations

Recommendation	Investigating Authority	Recommendation Number	Accident/Incident	Status
<p>The NTSB recommends that the FAA: require that Air Carrier Principal Operations Inspectors review the training programs of their respective carriers and if necessary specify that they be amended to emphasize requirements: - For flightcrews to take immediate and aggressive action to determine the source and severity of any reported cabin fire and to begin an emergency descent for landing or ditching if the source and severity of the fire are not positively and quickly determined or if immediate extinction is not assured. - For flight attendants to recognize the urgency of informing flightcrews of the location, source, and severity of any fire or smoke within the cabin. - For both flightcrews and flight attendants to be knowledgeable of the proper methods of aggressively attacking a cabin fire by including hands-on-training in the donning of Protective Breathing Equipment, the use of the fire ax to gain access to the source of the fire through interior panels which can be penetrated without risk to essential aircraft components, and the discharge of an appropriate hand fire extinguisher on an actual fire.</p>	NTSB	Rec #: A-84-076	Cincinnati 02/06/1983 DC-9,	Closed - Acceptable Action
<p>The NTSB recommends that the FAA: require that Airplane Flight Manuals, Air Carrier Flight Operations Manuals, And Flight Attendant Manuals be amended to include comprehensive discussions and illustrations showing the proper use of a fire axe and the locations in each model of aircraft operated where a fire axe can be used safely to gain access to a fire or smoke emission source.</p>	NTSB	Rec #: A-84-077	Cincinnati 02/06/1983 DC-9,	Closed - Acceptable Action
<p>The NTSB recommends that the FAA: require that those interior cabin panels of transport category airplanes, including panels of the lavatories and galleys, which can be safely penetrated with a fire ax be identified by an acceptable and standardized means.</p>	NTSB	Rec #: A-84-078	Cincinnati 02/06/1983 DC-9,	Closed - Acceptable Action

Table 2 Recommendations

Recommendation	Investigating Authority	Recommendation Number	Accident/Incident	Status
That appropriate regulatory authorities, in conjunction with the aviation community, review the adequacy of in-flight firefighting as a whole, to ensure that aircraft crews are provided with a system whose elements are complementary and optimized to provide the maximum probability of detecting and suppressing any in-flight fire.(A98H0003)	TSBC	A00-16 (TSBC)	Peggys Cove MD-11, 02/09/1998	Satisfactory Intent
That appropriate regulatory authorities, together with the aviation community, review the methodology for establishing designated fire zones within the pressurized portion of the aircraft, with a view to providing improved detection and suppression capability.(A98H0003)	TSBC	A00-17 (TSBC)	Peggys Cove MD-11, 02/09/1998	Satisfactory Intent
That appropriate regulatory authorities take action to ensure that industry standards reflect a philosophy that when odour/smoke from an unknown source appears in an aircraft, the most appropriate course of action is to prepare to land the aircraft expeditiously. (A98H0003)	TSBC	A00-18 (TSBC)	Peggys Cove MD-11, 02/09/1998	Fully Satisfactory
That appropriate regulatory authorities ensure that emergency checklist procedures for the condition of odour/smoke of unknown origin be designed so as to be completed in a timeframe that will minimize the possibility of an in-flight fire being ignited or sustained.(A98H0003)	TSBC	A00-19 (TSBC)	Peggys Cove MD-11, 02/09/1998	Satisfactory Intent
Appropriate regulatory authorities review current in-flight firefighting standards including procedures, training, equipment, and accessibility to spaces such as attic areas to ensure that aircraft crews are prepared to respond immediately, effectively and in a coordinated manner to any in-flight fire.	TSBC	A00-20 (TSBC)	Peggys Cove MD-11, 02/09/1998	Satisfactory in Part

Table 2 Recommendations

Recommendation	Investigating Authority	Recommendation Number	Accident/Incident	Status
<p>The NTSB recommends that the FAA: Issue an advisory circular (AC) that describes the need for crewmembers to take immediate and aggressive action in response to signs of an in-flight fire. The AC should stress that fires often are hidden behind interior panels and therefore may require a crewmember to remove or otherwise gain access to the area behind interior panels in order to effectively apply extinguishing agents to the source of the fire.</p>	NTSB	Rec #: A-01-083	Covington 17/09/1999 MD-88,	Closed - Acceptable Action
<p>The NTSB recommends that the FAA: Require principal operations inspectors to ensure that the contents of the advisory circular (recommended in A-01-083) are incorporated into crewmember training programs.</p>	NTSB	Rec #: A-01-084	Covington 17/09/1999 MD-88,	Closed - Acceptable Action
<p>The NTSB recommends that the Federal Aviation Administration: Amend 14 Code of Federal Regulations 121.417 to require participation in firefighting drills that involve actual or simulated fires during crewmember recurrent training and to require that those drills include realistic scenarios on recognizing potential signs of, locating, and fighting hidden fires.</p>	NTSB	Rec #: A-01-085	Covington 17/09/1999 MD-88,	Open - Unacceptable Response
<p>The NTSB recommends that the FAA: Develop and require implementation of procedures or airplane modifications that will provide the most effective means for crewmembers to gain access to areas behind interior panels for the purpose of applying extinguishing agent to hidden fires. As part of this effort, the FAA should evaluate the feasibility of equipping interior panels of new and existing airplanes with ports, access panels, or some other means to apply extinguishing agent behind interior panels.</p>	NTSB	Rec #: A-01-086	Covington 17/09/1999 MD-88,	Open - Unacceptable Response

Table 2 Recommendations

Recommendation	Investigating Authority	Recommendation Number	Accident/Incident	Status
The NTSB recommends that the FAA: Issue a flight standards handbook bulletin to principal operations inspectors to ensure that air carrier training programs explain the properties of Halon and emphasize that the potential harmful effects on passengers and crew are negligible compared to the safety benefits achieved by fighting in-flight fires aggressively.	NTSB	Rec #: A-01-087	Covington MD-88, 17/09/1999	Closed - Acceptable Action
It is recommended that for all large aeroplanes operating for the purpose of commercial air transport, the UK CAA and the EASA should take steps, procedural or technical, as are necessary to improve the reliability and availability of communications between flight and cabin crews, including the reliability of communications equipment and associated power supplies in both normal and emergency configurations. ¹	UK AAIB	2007-004 (UK AAIB)	Leeds DHC-8-400, 14/08/05	Closed
It is recommended that the UK CAA and the EASA review the current training requirements for cabin crew members in the use of smoke hoods to mitigate the communications difficulties which may be encountered and to improve the ability of all crew members to communicate while wearing smoke hoods. ²	UK AAIB	2007-006 (UK AAIB)	Leeds DHC-8-400, 14/08/05	Closed

1. This recommendation did not originate from an in-flight fire occurrence (it was a cabin air contamination incident); however, it is relevant to Cabin Crew fire training.

2. This recommendation did not originate from an in-flight fire occurrence (it was a cabin air contamination incident); however, the recommendations are relevant to Cabin Crew fire training.

INTENTIONALLY LEFT BLANK