ROYAL AERONAUTICAL SOCIETY

Smoke, Fire and Fumes in Transport Aircraft

Past history, current risks and recommended mitigations

Part 2: Training

Introduction

Smoke, Fire and Fumes in Transport Aircraft was first published in 2007

In 2012 the Flight Operations Group (FOG) decided:

- To republish SAFITA
- To publish a new and separate SAFITA to address aircraft crew training to deal with an in-flight fire.

SAFITA Part:1 Reference (Edition 2) was published in March 2013

In addition to the original SAFITA document, SAFITA Part 1: Reference, includes:

- Recent accidents and incidents.
- Lithium battery fires.
- Hidden fires.
- Composite materials.
- Predictive technologies.
- Amended recommendations.

SAFITA Part 2: Training

SAFITA Part 2: Training, was published in February 2014

SAFITA Part 2: Training, includes:

- Background and history of events including accidents and incidents.
- Theoretical and practical training of aircraft crew in dealing with an in-flight fire.
- RAeS FOG recommendations
- Guidance for meeting EASA training requirements for cabin crew in dealing with an in-flight fire.
- The ICAO guidance on how to deal with a lithium battery fire.
- Case studies of accidents and incidents, both non-survivable and survivable.

Peer Review

SAFITA Part 2: Training – The ‘Peer Review’ included:

- United Kingdom Air Accident Investigation Branch.
- United Kingdom Flight Safety Committee.
- The Honourable Company of Air Pilots.
- NASA Ames.

- European Aviation Safety Agency.
- United Kingdom Civil Aviation Authority.

Time is Critical

Time is very limited for the aircraft crew before an in-flight fire event becomes non-survivable, especially the case for a hidden fire.

National Aviation Authorities have stated:

- UK CAA: The average time for a hidden fire to become catastrophically uncontrollable was less than 20 minutes.
- FAA: Tests show that fires that spread to overhead areas may become uncontrollable in as few as 8-10 minutes.
- FAA: Delaying the aircraft's descent by only two minutes is likely to make the difference between a successful landing and evacuation, and a complete loss of the aircraft and its occupants.
- FAA: The time for the situation to become non-survivable is a little as seven minutes.
- FAA: In only one third of hidden fire events will the aircraft reach an aerodrome before the fire becomes uncontrollable.

Is the need for urgency in dealing with an in-flight fire stressed enough during aircraft crew training?

Training Priorities

The Flight Safety Foundation checklist priorities are:

- **Protection** – Delay in the use of protection equipment can have adverse consequences.
- **Checklist** – Action of the appropriate checklist as soon as possible.
- **Diversion and landing** – Preparation for a rapid diversion and/or emergency landing.

Crew fire-fighting procedures

For aircraft types with 3 or more required cabin crew, best practice specifies a team of three to deal with an in-flight fire:

- **The Fire Fighter –** The crew member who discovers the fire immediately fights the fire.
- **The Communicator –** Calls for assistance and alerts the flight crew.
- **The Coordinator –** Provides back-up fire-fighting equipment.

If protective equipment (PBE) is required then the roles of the fire-fighter may need to be switched from one crew member to another.

Where only one cabin crew member is carried, operators will need to consider how the different fire-fighting tasks will be completed.

Where no cabin crew are carried operators, will need to consider how the flight crew can best deal with the fire situation.

Crew fire-fighting procedures flight crew compartment fire

If a fire occurs in the flight crew compartment, the cabin crew may need to assist in dealing with the event. Procedures will need to include:

- Flight crew procedures for initial request of assistance and maintaining communication with the senior cabin crew member.
- Procedures for crossing the smoke barrier.
- Crew communication procedures while cabin crew are in the flight crew compartment.
- Flight deck workload and task allocation.

Communication and coordination

- The effectiveness of communication and coordination in the event of an in-flight fire is essential.
- This communication must be effective both ways, which can be difficult.
- All crew need concise and accurate information, including regular updates from cabin crew and flight crew briefing.
- Fire fighter and flight crew stress and workload need to be considered.

Practical Fire Training

In 2009 the UK CAA identified some level of non-compliance with the requirements of EU OPS.

The FOG identified a need for guidance on how to meet the requirements of EU OPS.

Practical difficulties of non-compliance include:

- The Montreal Protocol prohibits the discharge of Halon during training.
- Alternative extinguishing agents used in training are not representative of Halon.
- The amount of pressure on training fire extinguisher operating handles is sometimes less than on operational units.
- PBE neck seals used in training are seldom representative since they are damaged due to continual use.

Practical Fire Training

Additional Issues

- Fires used in training are often very small.
- Often there is no real challenge to the aircraft crew in extinguishing a fire in training.
- Fire re-ignition is not always covered during practical training.
- Sometimes separate training scenarios are used for fire extinguishers and PBE.
- For some gas-powered fire training rigs the extinguishing of the fire is under the control of the instructor.

Flight Crew Training Considerations

- Flight Safety Foundation have developed an integrated checklist for flight crew.
- After protection, fighting the fire is top priority.
- If fire is not immediately extinguished, early decision to divert is vital.
- Flight crew and cabin crew training needs to be combined.
- For aircraft operating without cabin crew, training should include cabin fire fighting and passenger handling.
- Training does not normally include practice in transferring from cockpit protection equipment to portable protection equipment.
- Recent accidents/incidents have shown that flight crew familiarity with cockpit oxygen masks is sometimes lacking.

Maintaining the smoke barrier

Minimising the migration of smoke from the cabin into the flight crew compartment is essential for continued safe operation

In most large aircraft the flight crew compartment door is the smoke barrier.

Smaller aircraft may be fitted with a curtain or nothing at all.

The following issues should be addressed in procedures and training:

- In the event of an in-flight fire the smoke barrier must be maintained, and
- The interphone system is the primary means of communication between the cabin crew and the flight crew

Hidden Fires

Hidden Fires

- Are not readily accessible, may be difficult to locate and may be difficult to extinguish.
- May be behind sidewall panels or in overhead areas.
- Present significant problems for the crew in identifying the location and source of the fire.
- Create difficulties for effective discharge of extinguishing agents.

For many years aviation safety agencies have raised the issue of hidden fires.

However, there is a lack of specific NAA requirements to address this issue, although some advisory material has been issued.

Location of crash axes and crowbars

- For EASA aircraft with less than 200 passengers seats the only crash axe or crowbar is located on the flight deck.
- For EASA aircraft 200 or more passengers seats, an additional crash axe or crowbar is located in the cabin. This is not required by the FAA.
- For aircraft with 200 or less seats, the flight crew compartment door will need to opened if the crash axe or crowbar is required. (All aircraft for FAA.)
- Opening of flight deck door will result in the smoke barrier being breached and may result in smoke/fumes/fire entering the flight crew compartment.
- The main need for cabin crew to be able to use a crash axe or crowbar is to prise away cab in panels to access a hidden fire.

Electrical Fires

- Modern aircraft have ever-increasing number of electrical installations such as IFE, charging systems for PED's, electrically powered passengers seats, etc.

- Each electrical system in the passenger cabin or any area under the control of cabin crew should have a dedicated procedure to address associated electrical fire.

- All circuit breakers under the control of flight crew and cabin crew should have procedures and restrictions on their use especially in the re-setting of circuit breakers.

Lithium Battery Fires

- In recent years there has been a significant rise in the number of PEDs that are powered by lithium batteries.
- On a typical flight with 100 passengers there might be more than 500 lithium batteries.
- Lithium batteries present a potential in-flight fire risk since such fires are difficult to extinguish.
- Aircraft crew procedures and training should address exactly how to deal with a lithium battery fire.
- The use of PBE and fire gloves should be considered when dealing with a lithium battery fire.

Combi Aircraft Operations

- Combi aircraft are configured with passengers and cargo carried on the main deck.
- In the event of a cargo fire on the main deck the aircraft crew will need to fight the fire.
- Typically on the main deck of a Boeing 747 there are 6 or 7 containers or pallets.
- The size of a main deck cargo compartment is vast and is an environment with which the aircraft crew are not familiar.
- Communication with other crew members from the main deck cargo compartment presents several difficulties

Fire Training Instructors

- The operator's requirements for the qualification and experience of fire training instructors should be specified in the Operations Manual.

- Fire training instructors should have:

  - Experience in theoretical and practical fire training.
  - Competency in instructional techniques.
  - A good working knowledge of aircraft crew operating procedures in respect of an in-flight fire for the aircraft types to be operated.
  - A good working knowledge of relevant parts of the Operations Manual and any associated Safety Notices.

Third Party Training

- Many operators outsource their aircraft crew fire training to third party training organisations.

- Third party fire training should:

  - Adhere to the same standards as if the operator was providing the training.
  - Be subject to a continual audit process by the operator.
  - Be consistent with the procedures in the operator's Operations Manual and Training Manual.
  - Be consistent with the operator's checking requirements.

EASA Cabin Crew Initial Safety Training Requirements

- The EASA requirements for initial fire training include some very significant issues and include:
  - Dealing promptly with in-flight fire and smoke events and identification of the fire source.
  - Informing the flight crew and actions necessary for coordination.
  - Frequent checking of potential fire risk areas.
  - Classification of fires and use of appropriate extinguishing agents.
  - Practical training in fire-fighting and in the donning of smoke protection equipment used in aviation.
  - Procedures of ground base emergency services.

- Despite the essential nature of this initial training it is only required once and are not covered in any recurrent training.

- If this training is not repeated at some stage in recurrent training it may lead to a lack of competence in subsequent years.

- Many operators include these EASA initial training requirements on a recurrent basis.

Recommendations

General

- **Recommendation 1:** Any aircraft crew training for handling smoke/fire/fumes events should emphasise the priorities of the FSF checklist template: ‘protection, checklist, diversion’. In particular the training should emphasise the urgency required in fighting an in-flight fire.

- **Recommendation 2:** Wherever practical, flight crew and cabin crew fire training should be combined to provide experience in effective coordination and communication between them.

- **Recommendation 3:** When the training of aircraft crew in fire-fighting techniques has been outsourced to a third party training organisation, the operator remains responsible for the content and consistency of such training and should ensure this through regular audit process.

- **Recommendation 4:** Operators’ should ensure that instructors’ assessment of crew proficiency in extinguishing fires is standardised, especially when the equipment requires the instructor to decide when the fire has been extinguished.

Recommendations

Training Equipment

- **Recommendation 5:** Aircraft crew fire training should be realistic in terms of fire-fighting equipment, aircraft types and operational procedures.
- **Recommendation 6:** Extinguishing agents used in training should be chosen to replicate most closely those used on board the aircraft to be operated.
- **Recommendation 7:** Extinguishers used in training should require the same degree of hand pressure to operate as operational units on board the aircraft.
- **Recommendation 8:** Operators should verify that seals on Protective Breathing Equipment (PBE) used in training are effective and replicate PBE carried on board the aircraft.

Recommendations

Training Equipment (cont)

- **Recommendation 9:** The difficulties in fighting a fire whilst simultaneously using fire extinguishers, PBE and fire gloves in a real fire situation on board an aircraft should be reflected as far as possible in training.

- **Recommendation 10:** Practical fire training should demonstrate the actual difficulties in communicating either face-to-face or by interphone with other aircraft crew members whilst wearing protective equipment.

- **Recommendation 11:** Operators that provide aircraft crew with containment devices should ensure that the procedures for their use are detailed in the Operations Manual and that aircraft crew are trained in their use.

- **Recommendation 12:** Operators should use realistic scenarios in training that follow the full sequence of events to an appropriate conclusion.

Recommendations

Fire Training Scenarios

- **Recommendation 13:** Operators should use training scenarios that require on-going communication between the cabin crew and the flight crew as the scenario develops.

- **Recommendation 14:** For operations without cabin crew, flight crew training should include the procedures for transferring from cockpit smoke protection to portable protection equipment.

- **Recommendation 15:** For operations without cabin crew, flight crew training should include the procedures for passenger handling in a smoke/fire/fumes event.

- **Recommendation 16:** Operators should ensure that there is regular and effective communication between the instructional team for aircraft crew safety and emergency procedures training and the flight crew instructional training for flight crew simulator training.

Recommendations

Fire Training Scenarios (cont)

- **Recommendation 17:** Flight crew training should emphasise that if the source of the fire is not conformed visually to be extinguished after initial actions the flight crew should initiate a diversion

- **Recommendation 18:** Flight crew oxygen mask training should ensure familiarity for use in an emergency situation.

- **Recommendation 19:** The problems and procedures for dealing with hidden fires, lithium battery fires, flight crew compartment fires and crew rest compartment fires should be addressed in practical fire training.

- **Recommendation 20:** In Combi aircraft, the special difficulties associated with access and unfamiliarity of crew with cargo compartments should be stressed in training.

Recommendations

Fire Training Scenarios (cont)

- **Recommendation 21:** Aircraft crew training should include an understanding of the vital requirement of maintaining a smoke barrier between the flight crew compartment and the passenger compartment (i.e. the flight crew compartment door).

- **Recommendation 22:** Operation of circuit breakers to isolate an electrical circuit and limit the continued ignition source of the fire should be addressed in both flight crew and cabin crew training together with the restrictions on their use.

- **Recommendation 23:** Where a flight requires only one cabin crew member, he/she should be trained in the responsibilities and difficulties of managing a cabin fire situation and operators should develop specific procedures for dealing with an in-flight fire in such circumstances.

- **Recommendation 24:** Where a flight is permitted to operate without any cabin crew, operators should develop specific procedures and training for flight crew to deal with an in-flight fire and any passengers on board.

Recommendations

Regulatory Improvements

- **Recommendation 25:** National Aviation Authorities (NAAs) should conduct a comprehensive review of aircraft crew training requirements in the light of SAFITA Part 2: Training, as well as other industry initiatives, and determine the need for future rule-making in the long-term and the issuing of advisory material in the short-term.

- **Recommendation 26:** EASA should review their fire training requirements and determine what changes might be appropriate to address the problems for aircraft crews in dealing with hidden in-flight fires.

- **Recommendation 27:** The EASA requirements (and, if applicable, other NAA requirements) for cabin crew initial fire training should be repeated on a three-year cycle to ensure continued competence.

Appendices

1. The EASA Requirements for Cabin Crew Fire Training and FOG Suggested Guidance Material.

2. Actions taken by aviation safety agencies in respect of in-flight fire:
   - US National Transportation Safety Board
   - US Federal Aviation Administration
   - UK Civil Aviation Authority
   - Canadian Transport Safety Board

3. ICAO – Dangerous Goods

   Recommended practice for dealing with an in-flight lithium battery fire

4. Case Studies – Catastrophic In-flight Fires

Future Plans

- Both parts of SAFITA are considered by the FOG to be ‘live’ documents.

- SAFITA Part 1 will be reviewed again in 2014 in light of findings during the development of SAFITA Part 2

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