Task and Resource Analysis of Rescue and Firefighting Services at Airports

Intermediate Report

October 2015

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Introduction

At a meeting with the management of the Regional Airports and Keflavik Airport (KEF), a working group was established to prepare and develop a task and resource analysis for rescue and firefighting services at airports, in accordance with the provisions in the new European Commission Regulation for Aerodromes (EU) No. 139/2014.

Requirements

The current Regulation No. 464/2007 on airports defines requirements for the number of employees for rescue and firefighting services in Category 1 airports as follows, in Article 25.a:
During service hours, Category 1 airports shall have one supervisor of rescue and firefighting services who has been trained as a professional firefighter, in accordance with Regulation No. 792/2001 on the Firefighters School and the Rights and Duties of Firefighters, or who have comparable training approved by the Icelandic Civil Aviation Administration, as well as specialised training cf. Articles 9.2.38 and 9.2.39 in Chapter VI. There should be at least two other fire and rescue service employees for each fire truck, with training as part-time firefighters, in accordance with the aforementioned regulation, or who have comparable training approved by the Icelandic Civil Aviation Administration, as well as specialised training cf. Articles 9.2.38 and 9.2.39 in Chapter VI.

Regulation No. 464/2007 has no requirements for other airports than those in Category I.

The new European Commission Regulation for Aerodromes (EU) No. 139/2014 has requirements for the number of rescue and firefighting personnel, as laid out in Article***AMC6 ADR.OPS.B.010(a)(2) Rescue and firefighting services PERSONNEL***:
The aerodrome operator should ensure that:
(a) during flight operations and at least 15 minutes after the departure of last flight, sufficient trained personnel is detailed and readily available to ride the rescue and firefighting vehicles, and to operate the equipment at maximum capacity;
(b) personnel is deployed in a way that ensures the minimum response times can be achieved and continuous agent application at the appropriate rate can be fully maintained, considering also the use of hand lines, ladders and other rescue and firefighting equipment normally associated with aircraft rescue and firefighting operations;

Further instructions on determining the number of personnel can be found in
GM2ADR.OPS.B.010(a)(2) Rescue and firefighting services NUMBER OF RFFS PERSONNEL:
In determining the number of personnel required to provide for rescue and firefighting, a Task and Resource Analysis should be performed, taking into consideration the types of aircraft operating at the aerodrome, the available rescue and firefighting vehicles and equipment, any other duties required from RFFS personnel, etc.

There are no further instructions or guidelines on how to carry out the task and resource analysis *Task and resource Analysis, TRA*) is to be performed. The draft revision of ICAO Doc 9137 – AN/898, AIRPORT SERVICES MANUAL, PART 1, RESCUE AND FIRE FIGHTING, Fourth Edition — 2014, Article 10.5 has instructions on how to carry out a task and resource analysis (TRA). See the chapter on TRA phases below.

Working Arrangements

Airports

The scope of Regulation (EU) 139/2014 covers airports with paved runways, which applies to all four international airports operated by Isavia: Keflavik Airport, Reykjavik Airport, Akureyri Airport and Egilsstadir Airport. The work was therefore focused on these airports. No decision has been taken on whether and how this work will be undertaken in regard to other airports.

Working Group

To perform the task and resource analysis for the above airports, a working group composed of representatives of KEF, FVM and ÞOS was formed. Its members are Fróði Jónsson, Richarður Þ. Ásgeirsson, Þorlákur S. Helgason, Magnús Ingólfsson, Ingólfur Gissurarson and Árni Birgisson. The working group met 11 times before presenting this report and recommendations for the next steps to the Managing Director of Isavia, Director of the Airports Division and Managing Director of Keflavik Airport.

Working Arrangements

The working group mostly followed the process detailed in ICAO Doc 9137, Part 1, Article 10.5, where the work is divided into 6 phases. To begin with, the task and resource analysis was based on accidents on the scale of Fokker F50, Bombardier Q-400 and B757 200.

The task analysis only took account of the tasks that rescue and firefighting services in airports are required to perform in the event of an aircraft incident. It was undertaken to determine the minimum number of personnel required to perform these services. The analysis was based on general conditions, not any particular airport, cf. the chapter on the next steps and the need to adapt the analysis to other tasks and conditions at each airport.

Analytical Work in the Nordic Countries

The working group examined the status of similar analyses at other airports, including via the Nordic CTIF group (International Association of Fire and Rescue Service) and the Nordic Airport Meeting (NAM). In general, work seemed to be in the early stages, but most expected to follow, or look to, the guidance in ICAO Doc 9137, Part 1, Article 10.5.

Interaction of Crew and Airports

When performing the analysis, the main factors that could affect the tasks of rescue and firefighting services were taken into account. The design of aircraft and the reaction of crew members following aircraft accidents are highly important in this regard. See footnote in Appendix 3 on three-part thinking in rescue and firefighting. See also the discussion on the work of aircraft crew in Appendix 6.

TRA Phases

1. First phase – Purpose and objective

In the first phase of the analysis, the purpose and objective of the rescue and firefighting services were defined in order to determine the tasks that the services are meant to cover, taking note of the internal and external requirements that apply to the service. See Appendix 1.

2. Second phase – Accident scenario

In the second phase of the analysis, an accident scenario is defined. The accident scenario should be a probable accident that would test a high number of factors in airport rescue and firefighting services. See Appendix 2.

3. Third phase – Type of aircraft

In the third phase, the reference aircraft to be used in the accident scenario was identified. The largest aircraft that regularly passes through the relevant airport was chosen. See Appendix 3.

4. Fourth phase – Location

In the fourth phase, the location of the accident scenario was determined. In addition to being a likely location for the accident scenario, the accident scenario should also be located at the furthermost runway end. See Appendix 4.

5. Fifth phase – Development of accident scenario

The fifth phase encompassed the development and description of the accident scenario on which the analysis would be based. This included the integration of data from phases 2–4. See Appendix 5.

6. Sixth phase – Analysis

The sixth and last phase included the actual task resource analysis. The main tasks deemed necessary were listed, along with an estimation of when they would be implemented, how long they would take and the minimum number of personnel required for each task. An overview of the analysis can be found in Appendix 6, along with notes and further discussion of matters relating to the analytical process.

Conclusions and next steps

The analysis identifies the minimum number of personnel needed to carry out the statutory tasks required from airport operators relating to rescue and firefighting services following an aircraft accident or incident.

The analysis does not take into account other tasks that personnel in rescue and firefighting services might perform as part of integrated tasks in airport services, e.g. monitoring of aircraft operating areas, winter maintenance, aviation protection, etc.

In order to complete the task and resource analysis, the analysis must be adapted to local conditions and other integrated tasks in the airport services at each airport, cf. the following guidelines.

It is suggested that the working group meet with the operators of these airports, to introduce the process and the proposed next steps, before applying the analysis to each airport.

Guidelines for the next steps in the task and resource analysis:

1. The airport nominates to a task force:
    a. 1–2 employees with wide-ranging knowledge and experience of rescue and firefighting services in the relevant airport.
    b. 1–2 employees with wide-ranging knowledge of management and integrated tasks in airport services at the relevant airport.
2. A representative of Isavia's TRA working group works with the airport's task force to perform further analysis.
3. Task force members begin by familiarising themselves with the contents of this report, with an emphasis on the analysis carried out by Isavia's working group, cf. Appendices 1–6.
4. The general analysis is applied to local conditions at the airport, placing an accident scenario at the furthermost runway end and taking note of actual driving distance.
5. A review must be undertaken to determine whether integrated tasks in airport services would affect or prevent the performance of rescue and firefighting services as defined in Appendix 6.
    a. This could be done by applying a scenario encompassing the allocation of tasks carried out by airport service personnel performing integrated airport service tasks.
    b. Note will be taken of how the personnel would, in an accident scenario, transfer to rescue and firefighting tasks. It must be kept in mind that requirements for response time are based on optimal conditions, cf. Appendix 4.
6. If it seems likely that other airport service tasks could affect the performance of rescue and firefighting services, cf. Item 5 above, adequate mitigating measures must be considered or else the minimum personnel needed at the airport to perform the rescue and firefighting services and other integrated airport service tasks that cannot be postponed and/or could prevent the rescue and firefighting services from being carried out.

Appendices

Appendix 1

1. First phase – Purpose and objective

Requirements

The description and demarcation of rescue and firefighting services, below, at airports is based on the requirements of Regulation (EU) No. 139/2014; Regulation No. 464/2007 (as subsequently amended); and SK 260-01, Compliance Guidelines for Rescue and Firefighting Requirements.

Objectives

Regulation (EU) No. 139/2014, Article GM1 ADR.OPS.B.010(a)(1) on Availability and Scope of Rescue and Firefighting Services:

The scope of the rescue and firefighting services is to save lives in the event of an aircraft accident or incident occurring at, or in the immediate surroundings of, the aerodrome. The operational objective is to create and maintain survivable conditions, to provide egress routes for occupants and to initiate the rescue of those occupants unable to make their escape without direct aid.

Demarcation

Rescue and firefighting services refers to the first response, to be secured by the airport operator in the event of an aircraft accident or incident occurring at or near the airport, until other respondents arrive at the scene. The response time of local fire brigades varies, but 12 minutes is used here, based on the fact that most larger fire brigades estimate that a fire truck will arrive at a site within 10 minutes of an emergency call being placed.

Rescue and firefighting services is an aviation safety service and extends beyond the services that the government and local authorities are obligated to provide. It is permitted to utilise airport rescue and firefighting services for other incidents, such as fire in buildings, provided that this does not have an impact on the airport's aviation safety services. There is no requirement to secure additional resources for airport rescue and firefighting services beyond those required by aviation safety criteria.

Implementation

To ensure the above rescue and firefighting services, adequate resources must be available at the airport, including competent and qualified personnel, vehicles, machinery and equipment necessary to provide the services.

Scope and guidelines for implementation

The scope of resources shall take into account the fire response level of the airport, the size of the aircraft frequenting the airport and the organisation and allocation of tasks in airport services. The airport operator shall arrange and operate airport service so that during air traffic hours, rescue and firefighting services can always be provided within a set time limit.

To ensure consistent implementation of requirements for airport rescue and firefighting services, Isavia has issued the document SK 260-01, Compliance Guidelines for Rescue and Firefighting Requirements. See e.g. Articles 3.4 and 45.

2. Second phase – Accident scenario

To facilitate the implementation of the project, it was decided to utilise one accident scenario, at least to start. It was decided to choose a scenario likely to test as many factors in airport rescue and firefighting services as possible. The scenario would therefore include fire in the aircraft, damaged escape routes and passengers unable to make their escape without direct aid.

When choosing an accident scenario, the following factors or criteria were considered:

- The accident record of the reference aircraft chosen in phase 3.
- Known accidents and incidents at or near Icelandic airports.
- Winter conditions in Icelandic airports.

The conclusion was that the most likely accident is a scenario where an aircraft veers off or overruns the runway. The reasoning included:

- Global accident records / accident analyses involving the reference aircraft Fokker 50, Q400 and B757 indicate the following:
    - Several recorded accidents involving F-50 and Q400, with most involving faulty landing equipment resulting in overruns. Only a portion of them involved fire.
    - Two B757 accidents, one overrun (no fire) and the other collision with a hijacked aircraft that was landing.
    - Two other accidents involving B757-200. One involved the marshalling of an aircraft in the apron, resulting in its wing colliding with another aircraft, the other a vehicle in the apron that collided with an aircraft. Neither incident involved injuries or fire in the aircraft.
- A large portion of accidents/incidents at Icelandic airports are overruns.[1]
- Winter conditions in Icelandic airports are likely to increase the probability of overruns:
    - Fluctuating temperatures make it difficult to ensure optimal braking conditions.
    - Heavy winds can affect landing conditions.

Whether taking into account analysis of accidents involving reference aircraft worldwide or aircraft accidents in Iceland in general, aircraft accidents at or near airports involving fire are very rare. It is nevertheless right to base the accident scenario on an overrun involving fire, as this complicates the response to the accident. However, the probability/risk should be evaluated at the close of the process.

[1] Based on the expert knowledge of working group members, not a review of data.

3. Third phase – Type of aircraft

The reference aircraft should be the largest aircraft that regularly passes through the relevant airport. The reference aircraft are as follows, based on air traffic data for the relevant airports:

- For Keflavik Airport: Boeing 757-200
- For the remaining three airports (RKV, AEY and EGS): Fokker 50. Due to the planned changes to Air Iceland's fleet, Bombardier Q-400 was also included.

The reference aircraft has various effects on TRA implementation, including:

- The length of the aircraft has an effect on the required fire response level and consequently the number of firefighting vehicles required.
- Number of seats on board, i.e. estimated number of passengers.
- Number of emergency exits and therefore the number of escape routes to protect. [2]
- Size and organisation of aircraft interior, e.g. number of levels and organisation of passenger cabin (wide body or not).

Aircraft	Aircraft length m.	Number of seats	Emergency exits	Fire response level	Number of fire trucks
Fokker 50	25,25	50	4	5	1
Bombardier Q400	33	74	4	6	2
Boeing 757-200	47	183	10	7	2
Boeing 767-300	55	230	8	8	3
Airbus 330-300	64	340	8	9	3

[2] Three-part thinking in rescue and firefighting is based on the interaction of three factors concerning emergency exits and the evacuation of passenger aircraft:

- Requirements for aircraft design:
  - That all passengers can be evacuated via 50% of the emergency exits within 90 seconds.
- Requirements for crewmembers:
  - That the crew can man 50% of the emergency exits to assist in evacuation.
- Requirements for airport rescue and firefighting services:
  - Includes securing egress routes for passengers.

4. Fourth phase – Accident location

It was decided to locate the accident scenario at the edge of the furthermost runway end, partially in order to have the longest response time possible as reference. Requirements for response time within an airport's operational area call for at least 50% extinguishing capacity being reached at the farthest runway end within 3 minutes and 100% within 4 minutes, under the best possible conditions (weather, visibility and driving conditions).
As response time requirements are based on optimal conditions, this must be taken into consideration when devising the accident scenario and during the analysis itself.
The location of the accident scenario is also based on the criteria and reasoning discussed in Phase 2.

5. Fifth phase – Development of accident scenario

The reference prepares for landing without any known complications. At the conclusion of its landing run, something goes wrong, resulting in the aircraft veering to the right off the runway. The aircraft stops in the critical area, ca. 10 m. off the runway end, with its right side facing the runway end diagonally. The right-side landing gear collapses, so the aircraft falls on its right side. Fuel leaking from the right wing catches fire, the fire reaching ca. 50% of the critical area. All emergency exits on the left side open easily, or are opened by the crew, except one that is stuck. It does not take much effort to open out. All right-hand emergency exits are closed (are stuck and/or not used by the crew to evacuate passengers due to the aircraft's positioning and the fire). Ca. 80% of the passengers are expected to exit without aid.

6. Sixth phase – Analysis

The Analytical Process in General

As stated earlier, the task and resource analysis was based on an accident scenario involving three different aircraft types, cf. Appendix 3: Fokker 50, Bombardier Q400 and Boeing 757-200.

It is worth noting that analysis such as this is limited by being an interpretation and execution of a hypothetical scenario where there may not be a single correct solution to the problem presented. This was reflected in the working group's discussions, and opinion was divided regarding some arrangements and solutions. Honest discussion always lead to a common agreement, however, based on the project's mission, i.e. to define the *minimal personnel required* to perform the *duties of airport operators regarding first response to an aircraft accident* at an airport.

Some factors in the analysis that gave rise to discussions and call for further explanation or reiteration:

Tasks of the Aircraft Crew

It was decided to estimate the evacuation by the crew in the accident scenario at just under 4 minutes, instead of the 90 seconds estimated by the manufacturer / aircraft operator. It was furthermore decided that evacuation would not commence until 30 seconds after the accident occurs. Despite this, evacuation of those who do not need aid is mostly complete by the time rescue and firefighting personnel arrive at the scene of the accident. It is worth noting that aircraft crew have appropriate protective equipment and standard evacuating procedures that are practiced regularly. This includes the crew overseeing the implementation of evacuation, manning at least 50% of the emergency exits and taking into account that jammed emergency exits must be opened and passengers need to be guided and assisted in exiting the aircraft and reaching safety.

Control of Procedures

It must at all times be clear who directs the first response at the site of an accident. The extent of management and strain due to managerial tasks is variable, depending on the number of personnel being managed and the extent and nature of the accident or incident being dealt with. The working group came to the conclusion that the extent of management in the Fokker 50 and Bombardier Q400 accident scenario, where minimum staffing was two personnel, did not require a full-time manager position, i.e. the manager plays a direct part in implementing procedures. In the Boeing 757-200 scenario, where minimum staffing is four personnel, the need for a full-time manager position is a matter of judgement.

Functionality of Fire Trucks

Fire trucks in Isavia's airports, other than Keflavik Airport, have a fire-fighting pump where only one pressure setting can be set at once. Thus, a roof turret and a handheld hose cannot be used simultaneously. In the Fokker 50 and Bombardier Q400 scenarios, extinguishing using a handheld hose can therefore not commence until the deluge gun is no longer being used.

Staffing of Fire Truck

There was agreement on the feasibility of staffing a fire truck, both as support for the man using the firehose and to make sure that the pump does not overheat. It was, however, not deemed necessary

to man the fire truck constantly, but a procedure must be implemented so that the firehose is never shut off completely, ensuring that there is constant water flow to reduce the chance of the pump overheating. This is the arrangement in the seven Icelandic airports where there is one person performing rescue and firefighting services.

Rescuing Those Who Require Assistance

Requirements for airport rescue and firefighting services mostly deal with targeted firefighting in a limited time period, as well as creating and maintaining survivable conditions and providing egress routes. It is also expected that the airport rescue and firefighting services can commence rescuing those who need direct aid. It is clear that the complete rescue of those who need assistance can prove to be an extensive task that requires considerable personnel, both from the airport and outside responders. There was some discussion on what the extent of rescue by airport personnel should be and how the safety of personnel could be maintained.. The working group concluded that once the accident site, egress routes and survivable conditions had been secured, rescuing could commence, depending on conditions and available personnel and without undue risks being taken.