Guidance on delivering an effective Airport Rescue and Fire-Fighting Service (RFFS)

Task and Resource Analysis

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Civil Aviation Authority
Aviation House
Beehive Ring Road
Crawley
West Sussex
RH6 0YR

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Enquiries regarding the content of this publication should be addressed to:

Safety & Airspace Regulation Group, Airspace, ATM and Aerodromes, Civil Aviation Authority,
Aviation House, Beehive Ring Road, Crawley, West Sussex, RH6 0YR.

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CHAPTER 1

Task and Resource Analysis

Introduction

This guidance describes the stages that should be considered when carrying out a Task and Resource Analysis (TRA) to establish justification with regard to the minimum number of qualified/competent personnel required to deliver an effective Airport Rescue and Fire fighting Service (RFFS) to deal with an aircraft incident/accident.

If it is required for the RFFS to attend structural incidents & road traffic accidents in addition to aircraft incidents/accidents due regard must be given to the inability of not meeting required response times and robust procedures should be introduced accordingly.

Purpose

By using a qualitative risk based approach, which focuses upon probable & credible worst case scenarios a task and resource analysis seeks to identify the minimum number of personnel required to undertake identified tasks in real time before supporting external services are able to effectively assist RFFS.

General Information

The minimum requirements should be established including: minimum number of RFFS vehicles & equipment required for the delivery of the extinguishing agents at the required discharge rate for the specified ICAO RFFS category of the airport.

Consideration should also be given to the types of aircraft using the aerodrome, vehicle(s) and the need for personnel to use self contained breathing apparatus, hand lines, ladders and other rescue and fire fighting equipment provided at the aerodrome associated with aircraft rescue and fire fighting operations. The importance of an agreed framework for incident command should form a primary part of the considerations.

Human Factors

The Task Analysis should observe human factor principles to obtain optimum response by all existing agencies participating in emergency operations. The principles should include the effects of human performance for example workload, capabilities, functions, decision aids, environmental constraints, team versus individual performance and training effectiveness. Knowledge, experience, staffing including numbers, skill levels and organizational structure, safety and health aspects, safety systems and protective equipment, not forgetting fatigue and the need for adequate relief should also be considered. The examples given are not exhaustive.

Task Analysis/Risk Assessment

A Task Analysis should primarily consist of a qualitative analysis of the RFFS response to a realistic, worst case, aircraft accident scenario. The purpose should be to review the current and future staffing levels of the RFFS deployed at the aerodrome. The qualitative analysis could be supported by a quantitative risk assessment to estimate the reduction in risk. This risk assessment could be related to the reduction in risk to passengers and aircrew from deploying additional personnel. One of the most important elements is to assess the impact of any critical tasks or pinch points identified by the qualitative analysis.

Qualitative Approach

The Task Analysis including a Workload Assessment aims to identify the effectiveness of the current staffing level and to identify the level of improvement resulting from additional staffing. Credible worst-case accident scenarios should be analysed to assess the relative effectiveness of at least two levels of RFFS staffing.

Quantitative Risk Assessment

This will generally be used to support the conclusions of the qualitative analysis by examining the risks to passengers and aircrew from aircraft accidents at the airport. This comparison of the risk allows the benefit of employing additional RFFS staff to be evaluated in terms of the risk reduction in passengers and aircrew lives saved. This could be expressed in monetary terms and may be compared with additional costs incurred in employing the additional personnel. However, this is of little, if any, value in determining minimum levels of personnel.

Task Analysis

The following items will assist in determining the basic contents of an analysis:

- Human factors
- Description of aerodrome(s) including the number of runways.
- Promulgated RFFS Categories (Aeronautical Information Publication).
- Response Time Criteria (Area, times & number of Fire Stations).
- Current & future types of aircraft movements.
- Operational Hours.
- Current RFFS Structure & Establishment.
- Current Level of operational crews
- Level of Supervision for each operational crew.
- RFFS Qualifications/Competence (Training Programme & Facilities).
- Extraneous Duties (To include Domestic & First Aid Response).
- Communications & RFFS Alerting system including Extraneous Duties.

- Appliances & Extinguishing Agents available.
- Specialist Equipment- Fast Rescue Craft, Hovercraft, Water Carrier, Hose Layer, Extending Boom Technology.
- First Aid- Role Responsibility.
- Medical Facilities- Role Responsibility.
- Pre-Determined Attendance: Local Authority Services- Police, Fire & Ambulance etc.
- Incident Task Analysis. (Credible Worst Case Scenarios) (Workload Assessment) (Human Performance/Factors). To include: Mobilisation, Deployment to Scene, Scene Management, Fire Fighting, Suppression & Extinguishment, Application of Complementary Agent(s), Post Fire Security/Control, Personnel Protective Equipment, Rescue Team(s), Aircraft Evacuation & Extinguishing Agent Replenishment. Note: The aim is to identify any Pinch Points within the current workload and proposed workload.
- Appraisal of existing RFFS provision.
- Future requirements. Aerodrome development & expansion.
- Enclosures could include: Airport Maps, Event Trees to explain tasks & functions conducted by the RFFS etc.).
- Airport Emergency Plan and Procedures.

Note: The above list is not exhaustive and should only act as a guide.

Phase 1

The aims and objectives of the RFF services must be clear with regard to the required tasks that personnel are expected to carry out.

Example

Aim

To maintain a dedicated RFFS of qualified and competent fire and rescue personnel equipped with vehicles and specialist equipment to make an immediate response to an aircraft incident /accident on or in the immediate vicinity of the airport within the specified response time criteria.

Principal Objective of the Rescue and Fire Fighting Service

The principle objective of the rescue and fire fighting service is to save lives in the event of an aircraft accident or incident occurring at, or in the immediate vicinity of, an aerodrome. The rescue and fire fighting service is provided 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. The rescue may require the use of equipment and personnel other than those assessed primarily for rescue and fire fighting purposes.

The most important factors bearing on rescue in a survivable aircraft accident are: the training received, the effectiveness of the equipment, the speed with which personnel designated for rescue and fire fighting purposes can be put into use.

Tasks:

- Meet the required response time.
- Extinguish an external fire.
- Protect escape slides and exit routes.
- Assist in the self-evacuation of the aircraft.
- Create a survivable situation.
- Rescue trapped personnel.
- Maintain post fire security/control.
- Preserve evidence.

Notes

The above list is not exhaustive and all relevant tasks must be identified before moving to Phase 2.

Each task/mission may include numerous functional activities/actions.

Phase 2

Identify a selection of representative realistic, credible accidents that may occur at the airport, this can be achieved by a statistical analysis of previous accidents on airports and by analysing data from both International National & Local sources.

Note - All incidents should involve fire to represent a credible worst-case scenario that would require an RFFS response.

Example:

- Aircraft engine failure on take-off with a fire (aborted take-off).
- Aircraft aborts and overruns into the Runway End Safety Area (RESA) with fire on take-off.
- Aircraft into aircraft with fire (collision)
- Aircraft on stand – adjacent terminal building(s) with a fire.
- Aircraft leaves the runway on landing into the runway strip (full emergency evacuation).
- Internal aircraft fire (Cabin fire, baggage hold, cargo hold, avionics bay(s)

Phase 3

Identify the types of aircraft commonly in use at the airport; this is important as the type of aircraft and its configuration has a direct bearing on the resources required in meeting Phase 1 above, it may be necessary to group the aircraft types in relation to common aircraft configurations for ease of analysis or identify precise aircraft type that may have a unique configuration.

Example

a) Long wide-bodied aircraft with multiple passenger decks and multiple aisles.

b) Long narrow-bodied aircraft with single aisle, high passenger density.

c) Short narrow-bodied aircraft with single aisle, high passenger density.

A representative aircraft type can then be chosen e.g.

- Airbus A 380
- Airbus A 350
- Airbus A 320
- Boeing 747
- Boeing 787
- Boeing 777
- Boeing 737

Phase 4

Every airport is unique in that the location, environment, runway and taxiway configuration, aircraft movements, airport infrastructure and boundary etc may present specific additional risks.

In order that the credible accident scenario can be modelled/simulated a major factor is to consider the probable location for the most realistic accident type that may occur.

To confirm the location of the scenario it is important that a facilitator using a team of experienced fire service personnel, who have knowledge of the airport and the locations in which an aircraft accident is likely to occur evaluate the scenario.

The role of the facilitator is to seek agreement in identifying the credible worst-case locations and by using a scoring system place these locations in order of relevance & priority. The team must determine why the locations have been identified and provide a rationale for each location. One methodology would be to award a weighted number, to each location, the total numbers can then be added up in relation to each identified location.

Example

The team may have identified that the following contributed to a worst-case location:

- Response Time.
- Route to the accident site (on or off paved surfaces).
- Terrain.
- Crossing procedures for active runway(s).
- Aircraft congestion on route (taxiways).
- Surface conditions.
- Communications.
- Supplementary water supplies.
- Adverse weather conditions- Low visibility Procedures.
- Daylight or darkness.

An additional time delay for any of the factors listed above should be estimated and recorded & the location with the highest additional response time could be identified with the worst-case location.

It is important to note that the location of an accident could have an impact on the resources and tasks that will be required to be carried out by RFF personnel.

From the above analysis a location or a number of locations could be identified, in agreement with the airport operator, the TRA facilitator and if necessary the regulator.

Example

1. Taxiway Bravo: Runway Holding Position Bravo 1- leading onto Runway 06L.
2. Runway 13- Runway & Service Road Crossing Point (Grid Reference A5).
3. Runway 28 Overrun - Runway End Safety Area (RESA)
4. Runway 24 Undershoot RESA
5. Aircraft Stand A33 (Alpha Apron).
6. Grid Reference A6 (Runway 06 Localizer Road)
7. Taxiway Alpha: Intermediate Taxi-Holding Position- A3
8. Aircraft Stand A5 (On taxi lane).

Phase 5

This Phase combines the accident types to be examined as described in Phase 2, with the aircraft identified in Phase 3 and the locations as described in Phase 4. The accident types should be correlated with the possible location, in some cases this could be in more than one location on an airport, for which a task and resource analysis needs to be carried out.

The above information is to be built into a complete accident scenario that can be analysed by experienced supervisors & firefighters for the task and resource analysis in Phase 6.

Example

Scenario No 1

- Accident Type: Aircraft Overrun into Runway 06 - Runway End Safety Area (RESA).
- Aircraft Identified: Boeing 747-400- Phase 3.
- Accident Location: Runway 06 RESA- Phase 4.

The Boeing 747 400 is a wide bodied multi deck aircraft, its typical seating configuration can be 340 Economy, 23 Business, and 18 First Class passengers on the lower deck. On the upper deck provision is made for a further 32 Business Class passengers, giving an estimated aircraft seating capacity of 413 excluding the crew. The aircraft typically has 4 exits on both sides of the lower deck and one each side of the upper deck.

During the take-off phase the aircraft suffers a fire in the number 3 engine and the pilot decides to abort the take-off. During this phase the fire develops rapidly and impinges on the fuselage. The aircraft overruns the runway and comes to rest in the RESA. Flight Deck Crew orders an evacuation.

The RFF services are informed by ATC and respond accordingly and the aerodrome emergency procedures are activated.

Phase 6

By using a TRA facilitator with teams of experienced airport supervisors & firefighters the accident scenario(s) developed in Phase 5 are subject to a task and resource analysis carried out in a series of table-top exercises/simulations.

When carrying out a task and resource analysis the principal objective should be to identify in real time and in sequential order the minimum number of RFF personnel required at any one time to achieve the following:

- Receive the message and dispatch the RFF service (the person initiating the response may also have to respond as part of the minimum riding strength).
- Respond utilizing communications, taking appropriate route and achieving the defined response criteria.
- Position appliances/vehicles in optimum positions and operate RFF appliances effectively.
- Use extinguishing agents and equipment accordingly.
- Instigate Incident Command Structure- Supervisors
- Assist in passenger and crew self-evacuation.
- Access aircraft to carry out specific tasks if required, e.g. fire fighting, rescue.
- Support and sustain the deployment of fire fighting and rescue equipment.
- Support and sustain the delivery of supplementary water supplies.
- Need to replenish foam supplies.

The task and resource analysis should identify the optimum time when additional resources will be available to support/augment and/or replace resources supplied by RFF services (Aerodrome Emergency Plan). It can also provide vital evidence to support the level of RFF vehicles and equipment.

In order to start a task and resource analysis the category of the airport must be identified as required by the regulatory authority, this should confirm the minimum number of vehicles, and the minimum extinguishing agent requirements and discharge rates, this should also determine the minimum number of personnel required to functionally operate the vehicles & equipment.

The results of the analysis should be recorded in a table or spreadsheet format and should be laid out in a method that ensures that the following is recorded:

- Receipt of message and subsequent response by the RFFS.

- Time: This starts from the initial receipt of call and the time line continues until additional external resources arrive or the facilitator decides an end time.
- List of assessed tasks functions and priorities are achieved.
- The resources (personnel, vehicles and equipment) required for each task is defined.
- Comments to enable team members to record their findings.
- Identified Pinch points

Working Example of a Qualitative Task Resource Analysis- Scenario 1.

- Major Foam Tenders are identified as MFT's A, B, and C & D.
- Minimum numbers of personnel riding the MFT's are identified as: A1, A2, B1, B2 etc. See Table 1.

Major Foam Tenders:

- 4 MFT's carrying 11,000 litres with a total water capacity of 44,000 Litres: (A, B, C & D)
- Minimum number of RFFS personnel: Total 14

Supervisors:

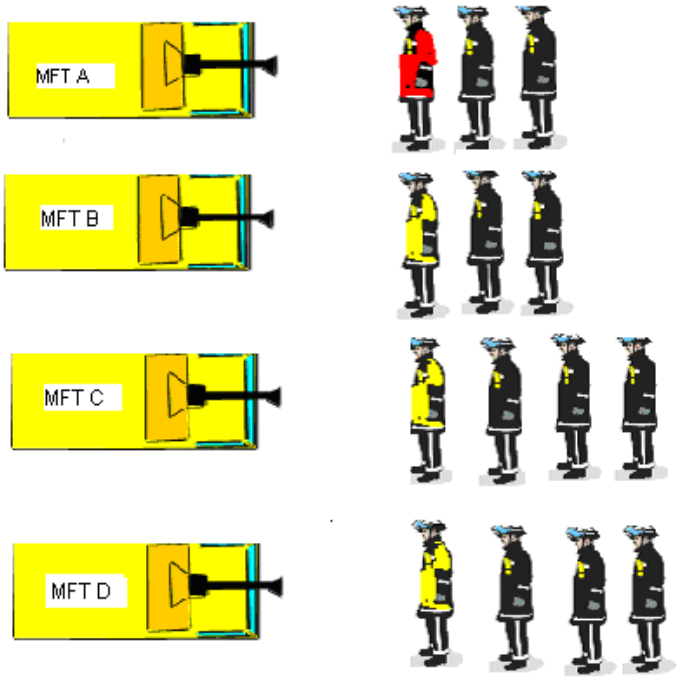
- Supervisor: 1= A1
- Crew Commander's: 3= B1, C1 & D1

Firefighters:

- Total- 10.
- A2 & A3.
- B2 & B3.
- C2, C3, & C4.
- D2, D3, & D4.

Worked example

Table 1: **Minimum numbers of appliances/vehicles & personnel riding the MFT's**



Notes:

1. For this example the RFFS is deployed from a single fire station at an airport with a single runway designated 06-24.
2. The TRA should ensure that the tasks could be conducted within the regulation relative to each member state.
3. Time has been defined in minutes and seconds.
4. For this TRA the dispatcher is outside of the minimum number of RFF personnel.

Stated objectives for the RFFS:

- Instigate aerodrome emergency plan.
- Respond within the required response time.
- Select appropriate route & communications.
- Position appliances in optimum positions and operate effectively.
- Instigate Incident Command System.
- Suppress/extinguish any fires.
- Assist with self-evacuation of the aircraft.
- If appropriate extinguish any internal fire.
- If required ventilate aircraft to create survivable conditions.

- Maintain post fire control of the critical area.
- Preserve evidence.

Table 2: **Task and Resource Analysis - Worked Example**

Time	Tasks	Resources	Comments
00.00	Call received from ATC as aircraft accident runway 06 RESA Boeing 747-400.	Watch-room Attendant and/or Air traffic controller	Achieved- ATC
00.00	RFF personnel mobilized.	Watch-room Attendant and/or Air traffic controller	Achieved
00.15	Call made to initiate the airport emergency plan.	ATC/Other Operations Unit.	Achieved- ATC
00.30	Personnel donning appropriate PPE and RPE.	Minimum riding strength BA equipment/Respirators	Achieved
00.40	Route selected & all appliances mobile en-route to 06 RESA.	MFT's A, B, C, & D.	Achieved-Supervisors & Drivers.
00.50	Supervisor(s) utilize appropriate communications (RTF): Discreet frequency, ATC, Local Authority etc.	Supervisor(s)	Achieved Note: Aircraft may have already instigated evacuation (Air Crew)
02.00	All appliances in position: Priority identified by Supervisor(s) to extinguish ground pool fire and fire in number 3 engine that is impinging on fuselage. A1 instigates ICS	Supervisors & Drivers. MFT's A, B, C & D. A1 Supervisor. B1 Supervisor. C1 Supervisor	Achieved A, B & C deploy monitors.

Time	Tasks	Resources	Comments
02.15	Create and maintain survivable conditions for the passengers to reach a place of safety. Complementary agent required. D1 is Supervisor. D2 is Pump Operator Breathing Apparatus (BA) Entry Control Officer (ECO).	D1 Supervisor A2 A3 B1 B2 B3 C1 C2 C3 C4 D2 D3 deploy, use of complementary agent, RFFS donned in RPE. D4	
03.15	All external fires extinguished.	MFT's A, B, C, & D. All Crewmembers.	Achieved.
03.20	Assist with self-evacuation, and maintain survivable conditions for the passengers to reach a place of safety.	MFT's A B. B1 A2 A3 B2 B3	Achieved: Hand lines deployed accordingly
03.20	Crew prepares to enter aircraft in respiratory protective equipment (RPE).	MFT D D1 D3 & D2 (Pump)	Achieved D1 D3 Briefed by BA ECO.
03.20	Crew prepares appropriate entry point and hand line. Note: MFT A maintains post fire control.	C1 C2 C3 C4 A2 A3	Achieved by use of: Specialist Vehicle/Equipment/ Ladder. Achieved
03.55	Crew enters aircraft in RPE with hand line. (ECO).	D1 D3.	Achieved

Time	Tasks	Resources	Comments
	Ladder made safe for internal crew. Crews assist with hand line for BA entry team	D4 C4 B2 B3	Achieved. Achieved. Achieved
04.15	Following a self-evacuation of the aircraft, provide assistance with mustering passengers and crew to a place of safety.	C1 C2 C3.	Achieved. Assistance provided by aircraft crew and additional responders from airport in accordance with the emergency procedures.
04.15	A2 remains as Monitor/Turret operator and provides escape route protection.	MFT A	Achieved
04.30	Supervisor A1 liaises with ATC, Rendezvous Point Officer & arriving emergency services to ensure appropriate resources are brought forward to the accident site/location.	A1	Achieved
04.50	Supervisor A1 instructs Airside Operations to assist in containing exiting passengers and crew and obtaining a head count of survivors.	A1	Achieved
04.55	D1 reports 20 passengers are still on board the aircraft that require medical aid and assistance. There is no smoke in the cabin or flight deck areas and those still on board are having no difficulty with breathing.	D1 A1	Achieved

Time	Tasks	Resources	Comments
05.05	External emergency services are brought forward to the accident site with additional equipment to support the removal of the remaining persons on board and to transport them to the appropriate safety zone.	A1 & external commanders: Police Fire Ambulance Medical Etc	Achieved
	Additional Points		
	Note 1: At this point the airport emergency plan is fully instigated and the supporting services can relieve D1 & D3 to provide supplementary water if required from the nearest hydrant or emergency water supply, assist in the deployment of specialist fire ground equipment and if required support the teams that are engaged in removing those that remain on board and/or the evacuees to a place of safety.		
	Note 2: The facilitator may decide to terminate the analysis at this point or continue with the exercise to evaluate specific elements of the emergency plan. E.g. Preservation of Evidence.		

Notes:

1. It can be seen that ten firefighters and four supervisors including the officer in charge are required to achieve the above supported by four Major Foam Tenders.
2. The time line can be further verified by the use of practical exercises & individual analysis to establish if the times are realistic and achievable for each task and function.

3. Each of the above tasks can be sub-divided into individual functions associated with the specific task performed at a particular time.

Example:

- How long does it take to don protective clothing?
- How long does it take to don self-contained breathing apparatus?
- How long does it take to slip and pitch a ladder
- How long does it take to open an aircraft door from the head of a ladder? (If required).
- How long does it take to deploy one, two, three (etc) lengths of delivery hose?
- How long does it take to carry any item of rescue equipment over a specified distance and get to work?

Table 3: RFFS Activities

Time Line Assessment for Personnel: Firefighters and Supervisors

This Table gives an indication of the time line from the above analysis and can be utilized to verify an individual task, function or identify “Pinch Points” ensuring each task is achievable effectively within the time line.

Task	**A1**	**A2**	**A3**	**B1**	**B2**	**B3**	**C1**	**C2**	**C3**	**C4**	**D1**	**D2**	**D3**	**D4**
Time														
00.00														
00.15														
00.30														
00.40	A1	A2	A3	B1	B2	B3	C1	C2	C3	C4	D1	D2	D3	D4
00.50														
02.00	A1			B1			C1				D1			
02.15		A2	A3	B1	B2	B3	C1	C2	C3		D1	D2	D3	D4
03.15														
03.20		A2	A3	B1	B2	B3	C1	C2	C3	C4	D1	D2	D3	
03.20														
03.20		A2	A3											
03.55					B2	B3				C4	D1		D3	
04.15							C1	C2	C3					
04.15														
04.30	A1													
04.50	A1													
04.55	A1										D1			
05.05	A1													

Note: From the above Table it can be seen that a potential Pinch Point exists with Firefighters A2 & A3. However, the tasks that they are performing are achievable as A2 & A3 are already utilizing a foam hand line to maintain the evacuation route and maintaining Post Fire Control. This is considered logical and an achievable process for this crew.

Conclusion

A task analysis can be as detailed as necessary. The aim is to itemise the knowledge and practical skills (doing) involved in carrying out the task or function effectively and to the correct standard of competence based on a qualitative analysis. Having gathered the appropriate data and agreed the outcome, the TRA should enable an RFFS to confirm and subsequently provide the correct level of vehicles, equipment and personnel. It would also enable the RFFS to develop a training specification and a learning programme can then be designed around role and task. When planning a Task & Resource Analysis ask the following questions:

- What is done?
- Why is it done?
- When is it done?
- Where is it done?
- How is it done?
- Who does it?

It is often difficult to assess the overall effectiveness of a complete unit by observation only. However, observation/demonstration does allow you to assess the effectiveness of individual units and any element(s) of the emergency arrangements.

Documentary evidence relating to previous accidents or exercises may also assist in establishing if the current RFFS is staffed at an appropriate level.

The overall objective is to be satisfied that the RFFS is organised, equipped, staffed, trained and operated to ensure the most rapid deployment of facilities to maximum effect in the event of an accident.

The above process can also be used to identify the types of equipment required, shortages in both personnel and equipment and training needs for personnel required to deal with identified tasks.